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VOL. CXLV.—No. 3766] LONDON: FRIDAY EVENING, MARCH 16, 1928 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

APPOINTMENT VACANT.
SUPERIOR ESTABLISHMENT.

Applications are Invited by the Hon'ble the Agent to the Governor-General in Baluchistan, Public Works Department, for a POST combining the duties of ELECTRICAL, BOILER and FACTORIES INSPECTOR. Applicant must have wide theoretical knowledge of Steam and Electrical Engineering, coupled with considerable experience in both branches; preference will be given to those having in addition some knowledge of hygiene and sanitation; proof of qualifications is required. Pay Rs. 1000-50-1200 with the possibility of permanent employment, non-pensionable; three years' probation, subject to three months' notice on either side, thereafter the appointment may be terminated at twelve months' notice. Travelling and out-station allowances on the usual scales as for a first-class officer; actual expenses incurred in India for joining will be paid.

Applications to the SECRETARY, as above, at Quetta, Baluchistan, India, will be received up to 18th April, 1928, and must state last appointment held. 7858

Assistant Engineers (10) REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably between 25 and 35 years of age, must have passed the examination for A.M.I.C.E. or possess a degree in civil engineering recognised by the Institution as exempting from Parts "A" and "B" of the examination. Must have had proper technical training and preferably have had not less than two years' subsequent experience on large engineering or municipal works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M. 254. 7956

Draughtsman Required by the GOVERNMENT of NIGERIA for RAILWAY CONSTRUCTION for a tour of 12 to 18 months' service, with possible extension. Salary £480, rising to £720 a year. Free passages and free quarters. When permanent quarters are not available, a commuted bush and travelling allowance of £9 a month is payable whilst engaged in the Colony upon construction work. Camp equipment provided. Outfit allowance of £60 on first appointment. Liberal leave on full salary. Candidates, aged 25 to 40, should have had good experience in the preparation of drawings for works in connection with the Construction of Railways.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M./465. 8034

Mechanical Engineers (TWO REQUIRED as TECHNICAL ASSISTANTS (unpensionable). Salary, £150, rising to £230 per annum, plus Civil Service bonus, giving a total at present of about £233 to £336. Candidates must be British subjects. Age 24)-27 years. Preference to ex-Service men, who will be allowed to deduct from actual age any period of service in the Forces between 4/8/1914 and 11/11/1918. Possession of a Degree in Engineering or Certificates of equivalent examinations essential; also suitable Workshop Training.

Application forms, returnable by 30th instant, may be obtained from CHIEF SUPERINTENDENT OF ORDNANCE FACTORIES, Royal Arsenal, Woolwich, S.E. 18. 8028

Ministry of Transport.
ROADS DEPARTMENT.
APPLICATIONS are INVITED for a POST as TEMPORARY ASSISTANT ENGINEER in London to deal with technical matters in regard to Road Vehicles. Candidates should be experienced men who have completed a recognised course of theoretical and practical engineering and have a knowledge of the law relating to the use and construction of automobiles. The salary ranges between £250 and £350, inclusive, according to experience and qualifications. Preference will be given to men who have served in his Majesty's Forces.

Applications should be made immediately in writing to the ESTABLISHMENT OFFICER, Ministry of Transport, 6, Whitehall-gardens, S.W. 1, stating age, qualifications, experience and references. 8027

Ministry of Transport.
ROADS DEPARTMENT.
TEMPORARY ENGINEER.
APPLICATIONS are INVITED for a TEMPORARY APPOINTMENT as ENGINEER attached to the Midland Division of the Roads Department with headquarters at Birmingham. Salary £400 per annum inclusive.

Candidates with experience under a Highway Authority and practical experience of modern Road and Bridge Construction are required. Preference will be given to men who have served in His Majesty's Forces.

Applications should be made immediately in writing to the ESTABLISHMENT OFFICER, Ministry of Transport, Whitehall-gardens, S.W. 1, stating age, qualifications, experience and references. 7978

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that ERICH PASKE, of German nationality, of 28, Fitgerstrasse, Bremen, Germany, and ACTIEN-GESELLSCHAFT "WESER," a company organised and existing under the laws of Germany, of 18, Werftstrasse, Bremen 15, Germany, SEEK LEAVE to AMEND the SPECIFICATION of the Application for Letters Patent No. 283,659, for an Invention entitled "Improvements in Steam Turbine Installation."

Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) of the 7th March, 1928.

Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

W. S. JARRATT,
Comptroller-General.

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The Engineer

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PUBLIC NOTICES

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Wednesday, 18th April, TENDERS for the SUPPLY of—

DRILLING MACHINES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each, which will not be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices, The White Mansion,
91, Petty France, Westminster, S.W. 1,
14th March, 1928. 8031

County Borough of Brighton. WATERWORKS DEPARTMENT.
PLANT FOR SALE.

The Waterworks Committee have FOR DISPOSAL the following PLANT:—

One 110 H.P. Cross Compound Horizontal Condensing Engine, built by Messrs. Yates and Thom, of Blackburn, in 1892, with cylinders 15in. and 28in. diameter by 27in. stroke, to run at 70 revs. per minute, with a boiler pressure of 110 lb. per square inch. The Engine is fitted with a shaft governor and automatic expansion gear on the high-pressure cylinder, heavy split fly-wheel 12ft. diameter by 24in. face, with outboard bearing, surface condenser, air pump, and all necessary stop valves, lubricators, &c.

The Engine is geared to drive two sets of three-throw deep-well pumps, 12in. diameter by 24in. stroke, running at 20 revs. per minute against a head of 200ft.

The rising mains consist of flanged pipes 12in. diameter and the depth from the engine-house floor to the snorers is about 185ft.

One Lancashire Boiler, by Messrs. Yates and Thom, 25ft. long by 7ft. diameter, insured for a working pressure of 110 lb. per square inch, grate area 27½ft., complete with all mountings.

The above plant may be inspected at the Patcham Pumping Station by arrangement. The pumps and rising mains have been removed from the well and the boiler taken off its seating, but the engine must be removed from its bed by the purchaser.

Sealed offers for the whole or part of the above to be addressed to the undersigned.

A. B. CATHCART, M. Inst. C.E.,
Waterworks Engineer.

12, Bond-street, Brighton,
March, 1928. 8009

PUBLIC NOTICES

County Borough of Swansea. MAIN DRAINAGE DEPARTMENT.
LLANSAMLET PUMPING STATION (CONTRACT No. 4a).

UNEMPLOYMENT RELIEF WORKS.

The Corporation invite TENDERS from Contractors experienced in Reinforced Concrete Work for the CONSTRUCTION of the above PUMPING STATION and incidental works.

The work consists of the following, all in Reinforced Concrete:—

Pump Chamber and Sump, 27ft. dia. by 33ft. deep.
Grit Chamber, 37ft. by 9ft. by 25ft. deep.
Superstructure, 67ft. by 20ft. by 16ft. high.
Electric Sub-station, 18ft. square by 20ft. high.
Culvert over Stream, 23ft. span by 56ft. long.
And also—
18in. dia. Cast Iron Pipes in Rising Main, 1100 yards long with tidal river outfall;
Boundary Walls and other incidental works.

Contractors desirous of tendering must notify the Chief Engineer, J. Richard Heath, Guildhall, Swansea, not later than March 29th, 1928.

All applications must be accompanied by a deposit of £5 (cheques to be made payable to the Borough Treasurer, which will be returned on the receipt of a bona fide Tender and the return of the specification and quantities intact, both of which are issued conditionally upon their being returned on or before April 16th 1928.

The general conditions, specification, bills of quantities and form of Tender will be forwarded to contractors about March 22nd, 1928. The contract drawings will be open for inspection at the office of the Chief Engineer at any time during office hours.

The lowest or any Tender will not necessarily be accepted.

Tenders shall be sent in to the undersigned by registered post, before Twelve Noon on the 16th day of April, 1928, endorsed "Llansamlet Pumping Station."

H. L. LANG-COATH,
Town Clerk.

Guildhall, Swansea,
7th March, 1928. 7964

SITUATIONS OPEN

WANTED, TECHNICAL ASSISTANT for the Patent Department of a large Electrical Manufacturing Firm, preferably one who has passed the Preliminary or the Final Qualifying Examination.—Address, stating age, experience, and salary expected, P4281, The Engineer Office. P4281 A

PUBLIC NOTICES

Grimsby Life-Boat Station.

The Committee of Management of the Royal National Life-Boat Institution are prepared to receive TENDERS for the REMOVAL of the whole of the Institution's BOAT-HOUSE SUBSTRUCTURE, BOAT-HOUSE, SLIPWAY and DOLPHIN near the Old Fish Dock Lock, Grimsby Harbour.

The substructure of the boat-house and the slipway below deck level and the dolphin consist of braced timber piles driven into the harbour bed. The piles are to be withdrawn. The boat-house is a timber-framed building covered with corrugated steel sheeting with side gangway and approach steps. The slipway consists of longitudinal and cross timbers and steel channel keelway with timber decking on one side only and a timber decked platform outside the boat-house. The materials removed will become the property of the contractor.

A form of Tender, terms and conditions of contract and specification can be obtained from Messrs. Lewis and Lewis, Consulting Engineers, 15, Victoria-street, Westminster, London, S.W. 1.

Tenders, which will only be accepted on the form supplied, are to be submitted on or before the 26th day of March, 1928.

The Committee of Management do not bind themselves to accept the lowest or any Tender.

GEORGE F. SHEE,
Secretary.

Life-Boat House,
22, Charing Cross-road, London, W.C. 2.
7975

Metropolitan Water Board.
TENDERS FOR THE SUPPLY AND ERECTION OF PUMPING MACHINERY AT THE HAMPTON PUMPING STATION, HAMPTON-ON-THAMES, MIDDLESEX.

The Metropolitan Water Board invite TENDERS for the SUPPLY and ERECTION of TWO SETS of VERTICAL CENTRIFUGAL WELL PUMPS and ELECTRIC MOTORS, &c., at their Hampton Pumping Station, Upper Sunbury-road, Hampton-on-Thames, Middlesex.

Forms of Tender, conditions of contract, specification and drawings may be inspected without payment of a fee at the Offices of the Board, Chief Engineer's Department (Room 173), on and after Friday, 16th March, 1928.

Contractors desirous of tendering may obtain the necessary documents from the Chief Engineer on production of an official receipt for the sum of One Guinea, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes addressed to the Clerk of the Board and endorsed "Tender for Sheffields Pumps, Hampton," must be delivered at the Offices of the Board (Room 122) not later than 10 a.m. on Tuesday, 17th April, 1928.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
9th March, 1928. 7979

Metropolitan Water Board.
MAINS FOR IMPROVEMENT OF SUPPLY, EAST OF WALTHAM ABBEY.

The Metropolitan Water Board invite TENDERS for the LAYING and JOINTING of the following CAST IRON MAINS, together with CONNECTIONS and CONTINGENT WORKS:—

2420 Lineal Yards of 6in. Main in Wood Green-road, Horseshoe-hill, and New-road;
833 Lineal Yards of 7in. Main in Bury-road;
all in the Urban District of Waltham Holy Cross.

The drawings and contract documents may be inspected without charge at the Offices of the Board, Chief Engineer's Department (Room 201). Forms of Tender, conditions of contract, specification, and bills of quantities, together with drawings and a spare copy of the bills of quantities, may be obtained from the Chief Engineer on production of an official receipt for the sum of £5, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings (with the exception of the spare copy of the bills of quantities, which may be retained by the tenderer). Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Mains for the Improvement of Supply East of Waltham Abbey," must be delivered at the Offices of the Board (Room 122) not later than 10 a.m. on Tuesday, 10th April, 1928.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
13th March, 1928. 8014

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PUBLIC NOTICES

Liverpool Corporation Water-WORKS.

THIRD INSTALMENT—VYRNWY SUPPLY. MALPAS COPEBROOK SECTION. CONTRACT NO. 5.

The Water Committee of the Liverpool Corporation is prepared to receive TENDERS for the SUPPLY of about 5¾ MILES of 42in. BITUMEN-LINED STEEL PIPES, together with a number of SPECIALS.

Specification and drawings may be inspected at the Water Engineer's Office, Alexandra Buildings, 55, Dale-street, Liverpool, on and after Friday, the 16th day of March, 1928. Copies of the specification and form of Tender may be obtained upon payment of a deposit of Five Guineas, which will be repayable upon receipt of a bona fide Tender and return of the documents and drawings issued.

Tenders, endorsed "Tender for Third Instalment Pipes," are to be sent through the post in a sealed envelope addressed to "The Town Clerk, Municipal Buildings, Liverpool," so as to be delivered not later than Twelve o'clock Noon on Monday, the 26th March, 1928.

The Water Committee do not bind themselves to accept the lowest or any Tender.

WALTER MOON, Town Clerk.

Municipal Buildings, Liverpool, 14th March, 1928. 7999

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. SOLID-DRAWN STEEL BOILER TUBES.
2. HELICAL and VOLUTE SPRINGS.
3. SPARE PARTS of CARRIAGES and WAGONS.
4. CYLINDRICAL BUFFERS.
5. POWER WIRING, CABLES and ACCESSORIES.
6. STEEL DRAW-BAR SHACKLES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Solid-drawn Steel Boiler Tubes," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 23rd March, 1928, in respect of Specification No. 5, and the 30th March, 1928, in respect of Specification Nos. 1, 2, 3, 4, and 6.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of the Specifications Nos. 1, 2, 3, 4, and of 5s. for each copy of the Specification No. 5, and of 2s. 6d. for each copy of Specification No. 6.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, the Company's Consulting Engineers, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD, Managing Director.

91, Petty France, S.W. 1, 16th March, 1928. 7977

City and County Borough of BELFAST.

APPOINTMENT OF CITY SURVEYOR AND ENGINEER.

The County Borough Council of Belfast invite APPLICATIONS for the above-named APPOINTMENT.

Salary £2000 per annum.

Conditions of appointment and form of application may be had from the undersigned, with whom the applications, endorsed "City Surveyor and Engineer," must be lodged not later than Saturday, 24th March.

Canvassing will be a disqualification.

R. MEYER, Town Clerk.

7984

Mersey Docks and Harbour BOARD.

ENGINEER-IN-CHIEF.

The Mersey Docks and Harbour Board invite APPLICATIONS for the POSITION of ENGINEER-IN-CHIEF to the Board, which will be vacant at the end of June.

Candidates, who should be under 50 years of age, must be members of the Institution of Civil Engineers and have had good experience in Dock and Harbour Construction and Maintenance and also in Estuary and River Training Works.

Applications, stating salary required, age, qualifications and experience, accompanied by copies of not more than three recent testimonials, to be sent to the undersigned not later than March 31st, 1928.

L. A. P. WARNER, General Manager and Secretary.

Dock Office, Liverpool, January 9th, 1928. 7981

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, WORKS MANAGER, Well Educated, with experience as Assistant Works Manager of large modern Engineering Works; age 35-40. Salary commencing £650 or more.—Address, 8021, The Engineer Office. 8021 A

ASSISTANT ENGINEERS.—APPLICATIONS are INVITED from qualified engineers with good experience of the Construction and Maintenance of Chemical and Metallurgical Plant.—Applications, stating qualifications, experience and salary required, to be made in writing to the CHEMICAL and METALLURGICAL CORPORATION, Astmoor Works, Runcorn. 8026 A

ASSISTANT POWER STATION SUPERINTENDENT REQUIRED in Buenos Ayres. Three years' agreement in first instance; commencing salary equivalent to £750 per annum; house provided at approximate rental of £100 per annum; free coal and light. Married man preferred, not over 30 years of age.—Address, stating age and giving at least two references and full particulars of training and experience, 7990, The Engineer Office. 7990 A

ASSISTANT WORKS MANAGER WANTED (About 30), for Engineering Works near Birmingham. Applicant must be able to handle men tactfully, and have a good all-round engineering knowledge, preferably college trained; salary £350. State full experience.—Address, P4287, The Engineer Office. P4287 A

COMPETENT and Experienced DESIGNER REQUIRED for Air Injection Diesel Engines, medium size. Applications, which will be treated confidentially, should state age with full particulars of experience, &c.—Box No. 967, Advertising Offices, 84, Queen Victoria-street, London, E.C. 4. 7976 A

ENERGETIC SALES ENGINEER as MANAGER for Manchester Office; age 30-40; must have good knowledge of Modern Boiler Plant and preferably connections with power station engineers.—Application, in writing, to HOWDEN-JUNGSTROM (RE-HEATERS) (LAND), Ltd., Caxton House, Westminster, London, S.W. 1. 8037 A

ENGINEERING ASSISTANT to WORKS MANAGER WANTED by Glasgow Firm doing fine work of highest class. Graduate with practical experience of accurate Fitting and Machine Work, about 25 years of age, wanted.—Address, stating age, training, and salary expected, 7996, The Engineer Office. 7996 A

FULLY Trained WORKS ENGINEER REQUIRED in North Midlands, to Take Charge of Maintenance, Repair and Construction Work in a Large General Steel Works, comprising Acid and Electric Melting Furnaces, Foundry, Forge, Machine Shops, Electric Sub-stations, &c.

Applicants must be not less than 35 years of age. Several years' previous experience as a plant and maintenance engineer is essential.

State fully, in confidence, particulars of training, previous experience, age, and salary required.

Address, 8024, The Engineer Office. 8024 A

MECHANICAL ENGINEER REQUIRED for Large Engineering Works in the Midlands. Preference given to university graduate with at least three years' practical experience.—Address, Box 3/HY, 8010, The Engineer Office. 8010 A

TEMPORARY CIVIL ENGINEERING DRAUGHTSMAN REQUIRED, with knowledge of Sea Works, Masonry, Steel Work, and Ferro-concrete Building Construction. Quick and neat draughtsmanship absolutely essential, and selected applicants will be subject to test. Age 23-28. Salary £4 per week.—Address, stating age, qualification, experience, and with copies two testimonials, 7980, The Engineer Office. 7980 A

TO PARENTS AND GUARDIANS.—CIVIL and MECHANICAL ENGINEER, M.I. Mech. E., with old-established business, has a VACANCY for a well-educated Young Man as ARTICLED PUPIL. Premium required.—Address, P4273, The Engineer Office. P4273 A

WORKS ENGINEER REQUIRED, with Pumping Machinery experience, used to accurate heavy work with general purpose machines and capable organiser. Experience of rate fixing and production costs essential. State experience, previous employers, salary required, and when disengaged.—Address, 8008, The Engineer Office. 8008 A

WORKS MANAGER for Bridge and Constructional Steel Works. Applicant must have held successfully a similar post, be able to make up estimates and have a thorough knowledge of piecework rates.

Address, stating age, experience, and salary, 7908, The Engineer Office. 7908 A

WORKS MANAGER REQUIRED by a Well-known Public Company, whose products are in great demand. Works are of a special engineering character. Expeditious output is particularly required. Applicants to state age, experience and salary required.—Write, Box 119, c.o. Mather and Crowther, Ltd., 10-13, New Bridge-street, E.C. 4. 8035 A

WANTED, a CHIEF DRAUGHTSMAN for an important Shipyard, to Take Charge of a Large Staff.

Applicants must have highest qualifications and good experience of various types of Vessels.

A first-rate salary is offered for the right man, who will have scope to display energy and ability.

Address in confidence, P4272, The Engineer Office. P4272 A

WANTED by Large Engineering Firm, JUNIOR DRAUGHTSMAN, preferably one with good knowledge of Oil Engine and Road Roller Work.—Address, 8033, The Engineer Office. 8033 A

WANTED, DRAUGHTSMAN for Estimating Department of North-East Coast Marine Engineering Works, able to get out machinery arrangements and estimates.—Address, stating age, experience, qualifications, and salary required, 7929, The Engineer Office. 7929 A

WANTED, First-class DRAUGHTSMAN. Structural Steelwork Design and Detail.—Address particulars and salary required to P4285, The Engineer Office. P4285 A

WANTED, TWO SENIOR DRAUGHTSMEN, with experience in Modern Cement Works and Construction of River Jetties. State age, experience, and salary required.—Address, 7915, The Engineer Office. 7915 A

COLLIERY DRAUGHTSMAN, Thoroughly Experienced in General Steel Structural Work in and about Collieries.—Apply, stating age, full particulars of training and experience, when disengaged, wages required, and copies only of recent testimonials, to TILMANSTONE COLLIERY, Eythorne, Kent. P4284 A

DRAUGHTSMAN, Junior, with Pumping Machinery experience, REQUIRED for East Midlands. State experience, previous employers, age, salary required.—Address, 8007, The Engineer Office. 8007 A

DRAUGHTSMAN REQUIRED for Machine Tool Work of latest design. Preference only given to man with such experience.—Address, stating age and salary required, 7946, The Engineer Office. 7946 A

DRAUGHTSMAN REQUIRED, Birmingham District; used to General Engineering and Steel Constructural Work.—Address, stating age, experience and salary required, P4298, The Engineer Office. P4298 A

DRAUGHTSMAN REQUIRED.—WANTED IMMEDIATELY, DRAUGHTSMAN having experience, especially in Powdered Fuel Work, by large industrial concern in Westminster.—Write, stating qualifications and salary required, to 8036, The Engineer Office. 8036 A

DRAUGHTSMAN WANTED for Machine Arrangements and Shop Details.—Apply by letter only, stating age, experience and salary required, to BAKER PERKINS, Ltd., Engineers, Willesden Junction, N.W. 10. 7991 A

DRAUGHTSMEN WANTED, Preferably with Experience on Aircraft Engine Design.—Write, stating age, full experience, and salary required, to BRISTOL AEROPLANE COMPANY, Ltd., Bristol. 7997 A

DRAUGHTSMAN WANTED, with Good General knowledge of Steam and Electrically Driven Pumps and having some workshop experience. Age not above 35.—Address, giving full particulars and salary required, 8005, The Engineer Office. 8005 A

DRAUGHTSMAN, with First-class Experience of Steam Turbine Design and Detail Work, for works in Midlands. State age, salary, experience, and when able to commence.—Address, 7980, The Engineer Office. 7980 A

DRAWING-OFFICE CLERK WANTED by Electricity Supply Authority in London district. Preference given to one experienced in D.O. records and photographic reproduction. Commencing salary £3 per week.—Address, 8004, The Engineer Office. 8004 A

ENGINEER - DRAUGHTSMAN, Preferably with experience in Repetition Production, also in Chemical Plant Lay-outs. Must have technical training. Interesting work with good prospects for energetic man. S.E. London.—Address, P4280, The Engineer Office. P4280 A

FIRST-CLASS MECHANICAL DESIGNER REQUIRED IMMEDIATELY for permanent position of Assistant Chief in Drawing-office, covering a wide range of coal-face and other machinery.

A general working knowledge of Electrical matters advantageous, but not essential.

When applying, quote age and give full details of experience.

Applicants must be capable of maintaining discipline and of taking considerable responsibility.

Address, 8020, The Engineer Office. 8020 A

JIG and TOOL DRAUGHTSMEN WANTED for Internal Combustion Engines. First-class men only.—Apply, stating experience, age, and salary required, to THE BRISTOL AEROPLANE CO., Ltd., Aero Engine Department, Filton, Bristol. 8019 A

JIG and TOOL DRAUGHTSMAN WANTED IMMEDIATELY, experienced in the design of Press Tools for Sheet Metal Work; must be an accurate and reliable worker.—Apply in writing, stating age, experience, salary required, and when available, to THE BRITISH THOMSON-HOUSTON CO., Ltd., Fittings Factory, Lower Hillmorton-road, Rugby. 8023 A

MECHANICAL DRAUGHTSMAN, Senior, Experienced in the design of Light Machinery, REQUIRED for Temporary Position, in South London.—Address, 8030, The Engineer Office. 8030 A

STEEL WORK DESIGNER, Also DETAILING DRAUGHTSMAN, REQUIRED for works in London, with experience in Steel-frame Factory Buildings.—Address, stating age, experience, and salary required, 8018, The Engineer Office. 8018 A

SYNTHETIC AMMONIA and NITRATES, Ltd. (associated with Imperial Chemical Industries, Ltd.), REQUIRE the SERVICES of SEVERAL DRAUGHTSMEN for each of the following classes of work :—

(1) General Architectural Draughtsmen used to planning, detailing quantities and specifications.

(2) Railway Draughtsmen used to lay-out and details of permanent way.

(3) Surveyors' Draughtsmen used to plotting surveys and the preparation of finished plans.

Applicants must possess first-class experience of the class of work in which application is made, and the salary offered will be between £250 and £400 per annum, according to qualifications.

Duties will commence in the drawing-office, but each post carries good prospects of promotion, which will be entirely dependent upon ability and personality.

Replies to be addressed to the CHIEF ENGINEER, Synthetic Ammonia and Nitrates, Ltd., Billingham, Stockton-on-Tees. 7867 A

TWO Experienced DRAUGHTSMEN REQUIRED in Structural Steelwork.—Address, stating age, experience and salary expected, P4301, The Engineer Office. P4301 A

ENGINEER WORKING FOREMAN WANTED for General Works, provincial district, about 20 hands. One used to Traction and Portable Engines, Repairs, Pumps and Agricultural Work; knowledge of drawing essential. Age 30 to 35. Two copies recent references. State salary if good house free.—Address, 7932, The Engineer Office. 7932 A

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Standardisation and Simplification.

ON Thursday of last week, March 8th, the President of the Board of Trade, Sir Philip Cunliffe Lister, presided at a meeting held to consider means for the further development of standardisation and simplification in British industry. Those attending the meeting included representatives of Government Departments, Chambers of Commerce, the Federation of British Industries, the British Engineering Standards Association, the British Engineers' Association, and the Iron and Steel, Motor and Electrical Manufacturers' Associations. Sir Philip reminded the meeting of the resolution passed at the Imperial Conference in 1926 urging the further development of standardisation in the widest sense of the term and of Imperial co-operation to that end. It was felt, he said, that before this country could participate effectively in an inter-Imperial movement some further progress towards standardisation and simplification would have to be made here. It was most desirable, he continued, that the valuable work conducted by the British Engineering Standards Association should be carried on and developed by that body. Great economies might, however, be effected in many trades by the process known as simplification or the elimination of unnecessary types of articles. The work involved could not, he held, be done effectively by a Government Department, but should be undertaken by a representative body in close touch with the various branches of industry. Subsequent discussion showed a general agreement among those present concerning the need for the further development of standardisation and simplification in this country, and it was decided to set up a committee of the associations and departments represented at the meeting to act as a central organisation for the promotion of the object in view. Mr. Herbert G. Williams, Parliamentary Secretary to the Board of Trade—and Secretary to the British Machine Tool Trades Association—was appointed chairman of the committee. The first meeting of the new body will be held on March 27th.

The First Lord's Statement.

IN his statement explanatory of the Navy Estimates for 1928, which Mr. W. C. Bridgeman issued at the end of last week, it is revealed that the net total of the Navy Estimates is £57,300,000, or £700,000 less than the original estimate for 1927. The reduction, it is remarked, would have been greater but for the fact that there are fewer obsolete ships to dispose of this year than last, and because there is a continued shrinkage in the quantities of stores available from stock in relief of cash expenditure. A sum of £9,629,857 is provided for new construction during the year. This amount is less by over £1,000,000 than it would have been had not the Government reduced the building programme by two cruisers in 1927 and one in 1928. The Fleet Air Arm is responsible for an increase of £198,000 rendered necessary chiefly because two new flights are to be formed for training purposes in anticipation of the reconstruction of the "Glorious" as an aircraft carrier. The Estimates, it is noted, have been prepared in light of the continued placidity of the general naval situation. Many important services, it is remarked, have either been deferred entirely or are being provided at a leisurely rate which the expectation of a prolonged period of peace alone warrants. In some "Notes on Matters of General Interest" appended to the statement it is recorded that an aeroplane launching catapult has been installed in the "Resolution" in addition to the "Vindictive," and that a number of different types are being made or designed with a view to comparative trials to determine the types suitable for the various classes of vessels. It is also stated that the Singapore floating dock should arrive at its destination about November, and be ready for use about four months later. Torsional vibration, it is noted, has caused some trouble in the 1928 "O" class of submarines, and, following investigations, important modifications have been made in the design of the motor shafts. One of the 1926 submarines has been fitted with a hydraulic clutch in place of the usual mechanical clutch to improve the flexibility and durability of its oil engines.

A New Process of Iron and Steel Production.

IT is announced that a company, the Duffield Iron Corporation, Ltd., has been formed under the chairmanship of Sir George Leon to develop the processes of iron and steel manufacture discovered recently by Mr. F. Lindley Duffield, chairman and managing director of Lindley Duffield and Co., Ltd., of London. Something has already been heard about Mr. Duffield's discoveries. They are based on the production of a high grade of gas from waste coal slack and the use of such gas instead of coke for fuel in blast-furnaces. We are informed that in order to prove the commercial possibilities of the Duffield processes an immediate start is to be made with the establishment of a demonstration plant in Oxfordshire, which will have an initial weekly output of 500 tons, rising after the first few months to 2000 tons. It is claimed for the processes that they permit the use of low-grade raw materials which cannot be treated economically by existing methods, and that they are particularly applicable to the vast iron ore deposits of Oxfordshire and Northamptonshire. It is also claimed that by their adoption the iron and steel industry of this country will be able to reduce its costs of production by 50 per cent. The results obtained at the demonstration plant will be scrutinised with interest.

Glasgow Harbour Developments.

AT a meeting of the Clyde Navigation Trust, held at Glasgow last week, the chairman, Sir William H. Raeburn, referred to the good progress being made with the new Shieldhall and Renfrew dock development scheme. It has now been agreed that a quay wall, 680ft. in length, to provide berthage at the east side of Dock No. 1, is to be built. Work upon it will begin not later than April 1st. The wall will be built on the monolithic principle and its estimated cost, excluding the cost of dredging and of the equipment, will be about £110,000, towards which a grant has been made by the Unemployment Grants Committee. The work is to be completed within a period of eighteen months from the date above mentioned. The question of a new fitting-out crane, which it is proposed should be erected to the west of the Finnieston high-level bridge now under construction, again came under consideration and alternative tenders are to be invited for cranes having a lifting capacity of 130, 150 and 175 tons. The present Finnieston fitting-out crane has a lifting capacity of 130 tons. Alterations and improvements, involving an expenditure of £30,000, are to be made at the Clyde-place Quay. They will include the reconstruction of the front of the quay and the provision of a new shed with waiting-rooms for passengers using the river steamers. In the course of his speech, Sir William Raeburn made mention of a recent comparison which had been drawn between the cost of handling cargo at Rotterdam and at Glasgow. A fairer comparison, he said, would be between Glasgow and other British ports, and with regard to that matter some figures were being prepared by the Trust for later publication.

Towing the Singapore Floating Dock

WITH reference to the statement of the First Lord of the Admiralty above quoted, regarding the new floating dry dock for Singapore, it can be added that the contract for towing the dock has been let by Swan, Hunter and Wigham Richardson, Ltd., its builders, to L. Smit and Co., of Rotterdam. The dock will leave the Tyne in two sections, each of which will be towed by four tugs. The voyage will in all probability begin in June, and as over 8500 miles have to be covered, it will take about four months. Various suggestions were put forward with regard to taking out the dock to Singapore. One was to employ Admiralty tugs from the dockyards, but that scheme was rejected, we understand, when it was found that such tugs would be absent from this country for nearly six months. Swan, Hunter and Wigham Richardson, Ltd., had contracted both to build and to deliver the dock, and as the firm itself could not carry out the towing work, it was decided to entrust it to Messrs. Smit, who have for many years specialised in long-distance tows, and have carried out successfully similar undertakings.

Seaplane Speed Record Fatality.

SOON after Flight-Lieut. Webster won the Schneider Trophy Race at Venice last September on a Supermarine-Napier S 5 seaplane, with a speed of 281·6 miles an hour, the Italian airman Major de Bernardi succeeded on a Macchi-Fiat machine in surpassing this record speed by travelling at no less than 297·7 miles an hour. It was always felt that the British machine on a straight course was capable of flying at a speed of over 300 miles an hour, and for some time past preparations have been in progress for an attempt to regain the world's speed record. The machine which was to have been employed was of the same design as Flight-Lieut. Webster's, and the pilot selected for it was Flight-Lieut. S. M. Kinkead, who in the Schneider Cup contest had flown a Gloucester Napier IV. machine, but had failed by a trifling accident to finish the course. The Supermarine Napier S 5 machine was described and illustrated in our issue of January 6th. To that account we have only to add that it is driven by a special Napier racing engine developing 875 horse-power. The attempt to establish the record was, after various trials, made on Monday evening off Calshot. The sea was calm, the wind light and visibility not too good. Hardly had the attempt begun when the machine was observed to dive straight into the water. It disappeared from sight and neither it nor its pilot were again seen. What happened it is impossible to say. It is quite possible that neither the machine nor the engine developed a defect, but that the accident was caused by a slight misjudgment on the pilot's part of his course or of a slight error in his instruments. He was flying at a speed of from 250 to 300 miles an hour at a height of about 160ft. above the water. A small mistake in estimating the horizontality of the path of flight at such a speed and such a height—a mistake that might easily be made in calm, misty weather over the sea—would spell speedy disaster. For example, if the flight path were but 5 deg. deflected from the horizontal, the water would be struck in 5 seconds, a short enough time for the pilot to realise that he was flying out of the horizontal and to make the necessary correction and for the machine to respond to the correcting force.

The Air Minister's Statement.

IN his Air Estimates speech delivered in the House of Commons on March 12th, Sir Samuel Hoare covered a wide field, extending from airships to engines, from civil aviation to the maintenance of the Air Ministry as a separate department. Dealing with airships, he stated that our two new 5,000,000 cubic foot vessels should be carrying out their flying tests by the summer and winter of this year. Both the airships, he said, could probably have been built in little more than a year, but in order to eliminate any avoidable risk, some three years had been spent on research and experiment. He claimed that the structure of the airships was stronger than that of any others previously built. It would appear from a subsequent remark that the Cardington airship is, after all, to be driven by heavy-oil engines. Dealing with civil aviation, Sir Samuel said that if it was to be made self-supporting, new types of machines and engines must be brought into use at comparatively short intervals. In 1922 the running cost per ton-mile was 4s. 2d. To-day, with three-engined machines, it was 1s. 10d. If that progress were maintained by the introduction of new types, the time was not far distant when civil flying would no longer need subsidising. The existing agreement with Imperial Airways, Ltd., did not afford either the time or the money to effect these improvements, and, accordingly, a new agreement was under discussion. The introduction of new machines was also effecting economies in the Royal Air Force, so much so that in the Estimates £200,000 less was taken this year for spares than last year. The programme of research and experiment was, however, being maintained in undiminished volume. Two items of interest in connection with it were the provision of a tank for testing model seaplanes, and a variable density wind tunnel for testing model aeroplanes. In 1922 less than £2,000,000 was spent on aircraft and engines. This year the Air Ministry was budgeting for £6,000,000 for the same purpose. Most of the new machines would be of metal construction. Seven types of metal machines would come into general use in the course of the year. He also indicated that considerable developments would be made in the use of flying boats.

The Charing Cross Electricity Supply Company.

THE annual ordinary general meeting of the Charing Cross Electricity Supply Company, Ltd., was recently held in London, when the chairman, Mr. F. W. Fladgate, presided. Referring to the company's affairs during 1927, Mr. Fladgate said that it was satisfactory to find that after paying all prior charges and setting aside the statutory sinking funds, it was possible to provide the £84,510 required for the standard dividend in the West End and to bring forward £43,000. As regarded the City, after making similar provisions and payments, it was possible to carry forward £16,000, making a total sum carried forward for the two undertakings of £59,000. During the year the capital charges in the West End amounted to £100,000 and in the City to £61,000, the bulk of which had been spent on the distribution system, the capital expenditure on generating plant being undertaken by the London Power Company. For the next year the capital expenditure on distribution would be considerable, for arrangements were being made to deal with a 100 per cent. increase in the consumption within the next ten years and automatic sub-stations were to be erected in various areas.

Shipyard Wages.

ON Wednesday last, March 14th, representatives of the trade unions which are embraced in the Federation of Shipbuilding and Engineering trades met together in London to consider jointly the proposal of the Shipbuilding Employers' Federation, to add to the restored bonus of 7s. an amount which would bring the total bonus of time workers up to 10s. The employers' proposal was to make such an advance if accepted in two equal instalments, in July and September, and the further condition was made that the unions jointly with the employers should agree in endeavouring to work out some index of prosperity for the industry by which wages might automatically be regulated. The conference decided that an effort should be made to obtain from the employers a better offer. It was stated that unless a further concession was made the shipyard workers who would benefit would be less than half the total number.

The Technical Fair at Leipzig.

THE great Technical Fair, held in Leipzig every spring, is too vast to change its character very quickly, so that the descriptions of it which we have given last year and the year before, hold in their main outlines for the Exhibition which opened on March 4th. The fine Fair ground with its thirteen large halls, crowded with machinery or apparatus of a technical nature, and the spaces between, also well occupied with machinery that needs no cover, afford scenes which vary little from year to year. Evidences of growth, however, are not wanting, and the Fair this spring is marked chiefly by the construction of a new

FIG. 1—NEW COMMERCIAL ROAD VEHICLE HALL

hall, or rather the reconstruction of an old one, to form a suitable setting for the exhibition of commercial road vehicles, the makers of which as a body had previously ignored Leipzig. The new hall, No. 7, replaces an old and inconvenient wooden structure, devoted to the shoe and leather trades in 1926, and to a most depressing exhibition of town-planning schemes last year. The roof has been removed, the innumerable wooden columns eliminated, and the labyrinthine arrangement which last year prevented the unhappy visitor from finding a short cut to the exit completely abolished. The hall now consists of an entirely open space about 320ft. wide by 450ft. long, without a single column or other obstruction—

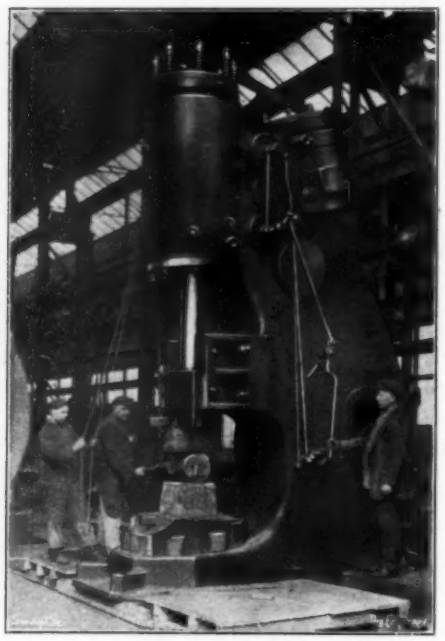

FIG. 2—2½-TON AIR HAMMER—EUMUCO

Fig. 1. The roof is carried by seven intermediate transverse lattice principals, giving a clear height of 58ft. from the floor. The principals, which are themselves nearly 28ft. deep, are invisible from the interior, the internal appearance of the roof being of the transverse ridge and valley construction with about one-third of its area glazed. Externally, the latticework buttresses which support the roof, and the roof principals themselves, are covered with slabs of artificial stone, with an effect not altogether pleasing, but one readily forgives this for the sake of the interior, which now constitutes a magnificent show hall, with what is claimed to be the largest single-span roof over any exhibition building in the world. It has no galleries, in spite of its great height.

The hall was well filled with motor vehicles, the predominant type appearing to be single-deck motor omnibuses, though lorries, tipping wagons, fire-service vehicles, tradesmen's delivery tricycles, &c., were all fairly represented. The bulk of the exhibits were German, as with the heavy import duties on motor vehicles in Germany, foreign makers have little chance to enter the market, except perhaps with light, fast and moderate-priced delivery vans. Of foreign firms, one Austrian, two French and two American companies were in evidence, the only vehicles of British manufacture we noticed being some motor bicycles and sidecars shown by the German agents of Messrs. A. J. Stevens, of Wolverhampton. The most imposing vehicles for road transport were the six-wheeled buses and lorries developed by Messrs. Büssing. These, which in the form of buses are familiar objects in many continental cities, are noticeable in that they have two driving axles, comparatively close together, each driven independently from the gear-box. The amount of the overhang of the body beyond the rear axle is also remarkable to those familiar with British practice, but experience would seem to show that this is permissible without unduly interfering with the handiness of the vehicle. The largest Büssing lorry we noticed was rated to carry 7½ tons. It was fitted with a 100/110 H.P. six-cylinder motor capable of giving it a normal road speed of 25 miles per hour in this pattern. All four driving wheels are provided with compressed air brakes. A similar chassis was equipped with a motor omnibus body, which is of special interest in view of the anxiety of the British railway companies to develop road transport. It was built apparently as one of a fleet to give a regular road service between Chemnitz and Leipzig, a matter of some 60 miles or so. The body takes the usual form of a single-deck continental omnibus, but internally it is divided into three compartments by transverse steel partitions. In the front one are twenty-eight seats, arranged in pairs on each side of the central gangway. The central compartment has luggage racks on one side and a completely fitted lavatory for all purposes on the other. The rear compartment is for smokers, and contains eight seats. The vehicle only needed a trailer with sleeping and eating accommodation to give all the amenities of a transcontinental express. The wheels are shod with balloon tires, 44 mm. by 1200 mm., and four-wheel air brakes are fitted. The body is ventilated by Flettner automatic exhausting heads, which were also shown independently by the Anton Flettner Company, whose name is well known in connection with the so-called rotor ships. The ventilator consists of a brass rotor mounted on a vertical spindle, the form being something like that of a broadish two-bladed rotor of a centrifugal pump. This is caused to rotate by the action of the air when the vehicle is in motion, and fan blades on the lower side draw the air from the compartment and expel it. The apparatus appears to be efficient and rain-tight.

We have spoken first of the Commercial Vehicle Hall because it is new, but the show of these vehicles, including the large number which constituted an overflow exhibition behind the hall, was not to be compared with the effort of the German machine tool makers to demonstrate that they are the tool makers of the world. The great hall, built only in 1924, by the Machine Tool Trades' Association, has really a considerably smaller exhibition space than Olympia with its extension, but the impression made by its setting and its striking architecture, and the excellent internal arrangements, is particularly effective. Year after year it is crowded with machinery in motion, without a single cubicle or enclosure to break the view nor advertisement of any kind to offend the eye. The names of the exhibitors are discreetly announced on artistic little signposts of uniform type at the corner of each stand, and that is all. One has only to consider the effect which such a display, repeated annually, must have on the foreign buyer to understand at least one of the reasons why on the Continent Germany is being more and more regarded as leading Europe, if not the world, in the production of machine tools. And with the prestige goes the trade.

While it seems invidious to pick out a few firms for special notice from among such a wealth of interest, it is fair to say that the heaviest machinery this year seemed to be displayed by the Eumuco Machine Tool Company, of Schlebusch-Manfort, near Cologne, and Messrs. Schiess-Defries, of Düsseldorf. In both cases it is to be noted that these heavy exhibits had to be transported right from the other side of Germany, and will have probably an equally long journey to their final destination. One never notices the same heavy machine displayed two years following at Leipzig, although as part owner of the hall the maker could probably keep it there if he desired to. The immense boring mill built by Messrs. Schiess-Defries for boring the casings of a 180,000-kW turbine, which we illustrated last year, has gone to its duty, and this year the firm gave the place of honour to the high-speed lathe, of which we gave photographs and full particulars in our issue of February 10th. This lathe was shown at work, its cutting speed being very impressive to the trained eye. It was the Eumuco exhibit, however, which caught the attention first. On the stand of this company was what is said to be the largest air hammer in the world, with a tup weighing 2½ tons. A good idea of the machine will be gathered from Fig. 2, which shows one of a similar type at work in the Eumuco shops. Power for working the compressor piston is obtained from an electric motor neatly combined with the design, and the machine appears every bit as handy to operate as the smaller sizes which are so common. Near this air hammer was a very large drop hammer with a falling weight of 6 tons. In the Eumuco design the usual belt-lifting arrangement is

FIG. 3—6-TON DROP HAMMER—EUMUCO

replaced by an air or steam cylinder, with the result that hammers on this principle can be constructed with falling weights up to as much as 25 tons, as against a maximum of about 5 tons with the old belt hammers. The machine is illustrated in Fig. 3.

The British exhibitors at Leipzig this year numbered fifty-one firms in all—not a very striking proportion of the 11,000 or 12,000 exhibitors in the whole Fair. If we except the stands of the railway companies, travel agencies, and publicity companies of various kinds, the number of stands concerned with British industry was still more insignificant. If, further, we deduct from these the exhibits of things like tennis racquets, soaps, perfumes, &c., the residue which represented the British engineering industries was a very small number indeed. Of the British engineering firms, three—Alfred Herbert, Ltd., Brooks and Doxey, and John Hetherington and Sons, Ltd.—were newcomers to the show, while Rose Brothers, Ltd., of Gainsborough, had exhibited their sweetmeat packing machines, &c., at Leipzig previously. The stand of Alfred Herbert, Ltd., excluded, of course, from the great hall of the German toolmakers, was situated in a much more modest building surrounded by a heterogeneous assembly of foundry machinery, &c. It attracted, however, well-deserved attention, for it exhibited the work of the British machine tool-maker in a manner which challenged comparison with anything to be seen at the Fair. The stand was a large one and contained five machines all working, namely, a No. 3 automatic, a No. 5 semi-automatic, a No. 11 hexagon turret lathe for bar work, a No. 9 combination turret lathe for both bar and chuck work, and a No. 4 capstan lathe. The machines had direction plates, &c., in German, and the literature on the stand was in five different languages. We illus-

trate the No. 5 semi-automatic in Fig. 4. The engraving shows it set up for machining aero-engine cylinders, and a sample of this work was shown on the stand, though the machine was then engaged on other work. There was probably no other machine at the Fair capable of competing with this on such work as aero-engine cylinders, or jobs requiring equally heavy forming cuts. The forgings, previously rough bored and turned, are gripped on a 15in. Coventry chuck, and the first operation consists in finish boring the interior and turning the flange. Boring is done by four equally spaced tools on a bar. The bar enters the cylinder, is moved sideways so as to engage the tools, and as all four are working at once the bore is completed with one-quarter the traverse and in one-quarter the time which would be required by a single tool. The second operation is to ream the bore with a bar having floating cutters. In the third operation the fins are rough formed and the flange is simultaneously faced. The fourth and last operation consists in finish forming the fins. The forming cuts are no less than 10·25in. wide. The complete machining of such a cylinder on the No. 5 semi-automatic takes only thirty minutes. It was encouraging to hear that Alfred Herbert, Ltd., are doing a large and increasing trade on the Continent, a fact which shows that quality of goods and efficient methods of business are sufficient to outweigh the handicap of price, even in lines such as machine tools, in which the competition of German manufacturers is so keen. The participation of Brooks and Doxey and of John Hetherington and Sons in the Fair was also said to be an outcome of the continental business in cotton spinning machinery which they had found it possible to develop. Inquiries at the stand of Rose Bros., Ltd., of Gainsborough, where an interested crowd was always to be seen watching the caramel packing machines at work, confirmed the possibility of British competition in the continental markets; while John Harper and Co., of Willenhall, makers of domestic hardware, expressed great satisfaction with the volume of actual and prospective business resulting from their first appearance at Leipzig.

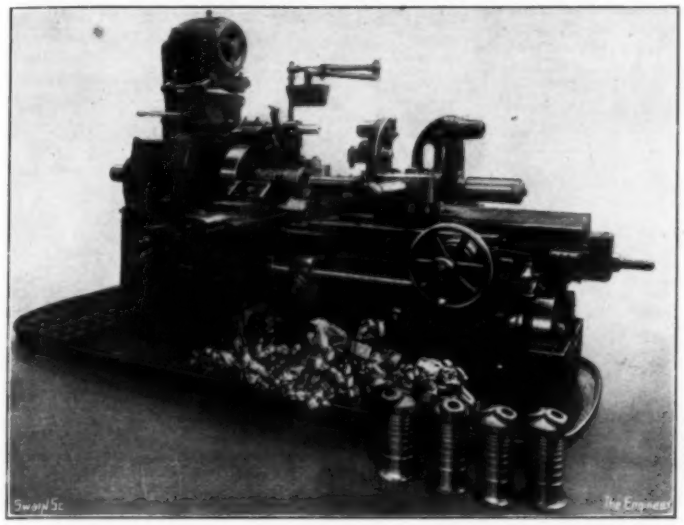

FIG. 4—NO. 5 SEMI-AUTOMATIC LATHE—ALFRED HERBERT

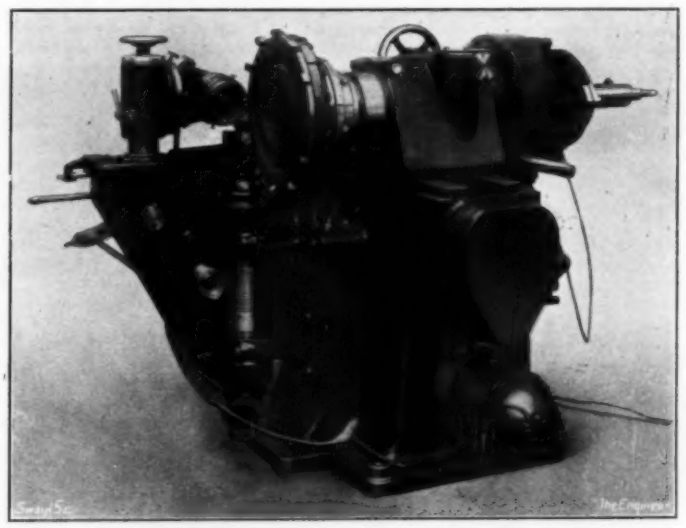

FIG. 5—CUTTER HEAD GRINDER—SCHIESS-DEFRIES

Among the machines exhibited this year by Messrs. Schiess-Defries, of Düsseldorf, was the cutter grinding machine—illustrated in Fig. 5. The machine has been designed for sharpening the tools of milling heads, and it possesses the special feature of having no dividing mechanism other than the tools themselves. The number of tools comprised in any milling head is immaterial, as each forms its own stop. The rotation of the head, to bring a new cutter into position to be ground is effected by a ratchet wheel just visible in the engraving, at the back end of the spindle. The ratchet lever, which can be given a widely varying stroke, is operated by a cam and link so that it moves only periodically. Before it begins to turn the spindle a stop piece supporting the tool which has been ground is automatically removed. This stop is replaced in readiness to receive the next tool, which is held hard on to it by a spring arrangement in the link, which operates the ratchet lever. The grinding wheel is carried on a reciprocating head, with respect to which it has universal adjustment. The head works in slides on a sort of kneepiece which can be rotated on a vertical axis, through 90 deg., so that cutters can be ground to any desired form. Even curved profiles can be given if required. The machine illustrated will grind milling heads from 150 mm. to 800 mm. diameter. The main driving motor is rated at 0·45 H.P., and the grinding motor at 0·4 H.P.; the weight is about two tons. A larger model is made, capable of dealing with milling heads from 300 mm. to 1400 mm. diameter. Another tool grinding machine exhibited by Messrs. Schiess-Defries is illustrated in Fig. 6. This machine is designed for lathe or planer tools, and is fully automatic. The tool holder has universal adjustment. The grinding capacity of the machine is such that all tool forging may be eliminated, the bar steel being sawn through at an angle, and the grinding machine doing the rest. Tools of 1in. square section can be ground in about two minutes, and those of 1¼in. square section in about eight minutes. Grinding wheels of 250 mm. diameter are employed running at 1900 revolutions per minute, and about 4 H.P. is absorbed by the work. The maximum length of cross-traverse is 140 mm., and of longitudinal traverse 190 mm. The motor is built into the base of the machine, as shown in the illustration, and the tension kept on the first belt-drive by a jockey-pulley and a weighted lever.

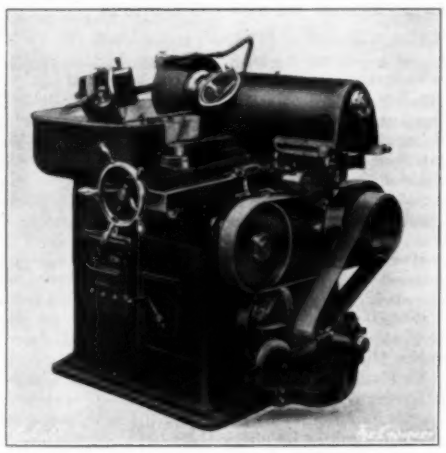

FIG. 6—TOOL GRINDER—SCHIESS-DEFRIES

There was also on the stand of Messrs. Schiess-Defries a very simple and ingenious device for doing facing or taper work on a horizontal boring machine. On the face plate of the machine was bolted a slide rest, carrying a tool-box capable of a suitable motion radially across the face plate. The tool-box casting was provided with a rack which geared with a wheel on the axis of the machine spindle. The bore of this wheel was furnished with internal spiral grooves, the wheel being mounted on a spirally splined spindle. This spindle could be fed forward relatively to the main spindle, but could not rotate relatively to it, so that its forward feed caused the toothed wheel to turn and the tool to be given a radial motion. The gear wheel was readily removable without disturbing the work, so that the facing and tapering motion could be put out of action in a simple manner. The whole arrangement was very neat and appeared an obvious improvement on the old method of getting a cross-traverse of the tool by a star-wheel coming in contact with a stop at every revolution.

A somewhat striking exhibit staged in the Machinery Hall by Messrs. Friedrich Schmaltz, of Offenbach-on-Main, is illustrated in Fig. 8. The idea was to show the application of some of the firm's various types of grinding machines to the purposes of the locomotive repair shop. The exhibit consisted of a fairly realistic model of a locomotive under repair, with a self-contained grinding machine occupied in facing up the steam dome flange, another facing up the exhaust pipe flange, a third facing up the cylinder cover joint, and two others working simultaneously on the four faces of a pair of axle-box horn-plate cheeks. The locomotive was mounted on a bearer under the cylinders, and another under the back end of the framing. Each bearer beam was carried by two columns, which could be raised or lowered together or independently by the hand wheels shown. The most elaborate of the grinding machines were those engaged on the horn-cheeks. In these appliances each of the two heads carries a pair of outward-facing grinding wheels driven by a motor between them. The slide carrying the heads is traversed to and fro on a fixed bed, which is provided with all the necessary adjustments. The automatic reciprocating motion is given by means of oil pressure provided by a pump, and the speed of traverse can be regulated to the greatest nicety by merely adjusting a control tap. One very ingenious feature, embodied in many of Messrs. Friedrich Schmaltz's grinding machines, is that the motors are constructed with the "rotor" fixed, the outer part, which is normally, of course, stationary, revolving. The external surface of the motor can thus be used as a belt-pulley, a possibility which frequently results in a great simplification of the design of the machine, especially in portable apparatus where space and weight are so important. Furthermore, it is possible to build a 3 H.P. motor only 85 mm. in axial thickness, with a rotor suitable for the direct attachment of grinding wheels up to 550 mm. diameter. Such motors are used by the firm for grinding units which will operate in the confined spaces of assembled locomotive wheels and crank axles. Of the more usual types of grinding machines exhibited by Messrs. Schmaltz we can only illustrate the saw-sharpening machine—shown in Fig. 7. This is one of a series designed for automatically sharpening circular saws of any size and shape of tooth.

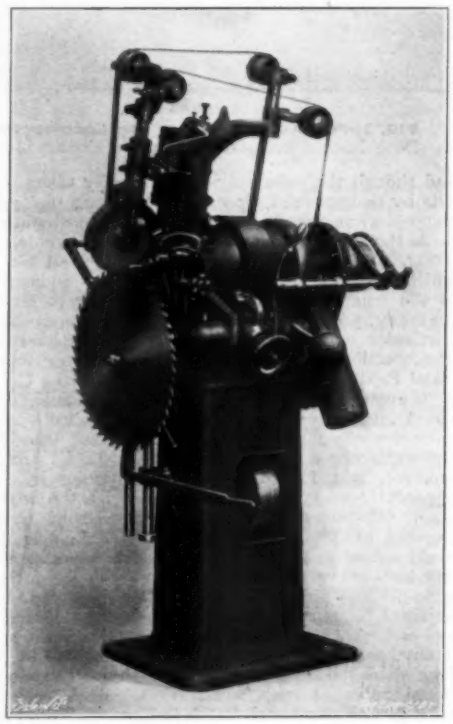

FIG. 7—SAW-SHARPENING MACHINE—SCHMALTZ

Fig. 9 is from a photograph taken in the Machine Tool Hall, and shows a large double mortising and planing machine on the stand of Messrs. Böttcher

and Gessner, of Altona-Bahrenfeld. It has twelve spindles and can be adapted to the mass production of furniture, doors, windows, wagon parts, &c. There is a complete absence of belt driving in the machine. The two sides can be worked separately or in conjunction with each other. In Hall No. 21 were collected practically all the oil engines at the Fair other than those running in the open. Deutz Company, of Cologne, exhibited no less than seventeen motors, all running, ranging from 1¾ H.P. to 200 H.P. The largest machine we noticed in the hall was a six-cylinder 350 H.P. engine of the Maschinenfabrik-Augsburg-Nurnberg, driving an alternator. Altogether we counted over fifty oil engines running in the hall, a multitude more forming parts of road rollers, road-making machines, excavators, pumping sets, and other machines to which such prime movers could be adapted. These machines were open-air exhibits and formed part of a collection which, taken together, constituted a very considerable part of the Technical Fair. Some of the structures put up to illustrate hoisting and conveying apparatus were really striking, but possibly the most noteworthy of the out-of-door structures was a complete well-drilling rig, with a steel tower, apparently about 100ft. high, surmounted by an immense star-shaped sign which was illuminated at night. Manufacturers must have considerable confidence in the business possibilities of the Leipzig Fair to go to the expense of advertising their products on such a scale, but the motto of the exhibitors throughout seemed to be that if a thing was worth doing at all it was worth doing well.

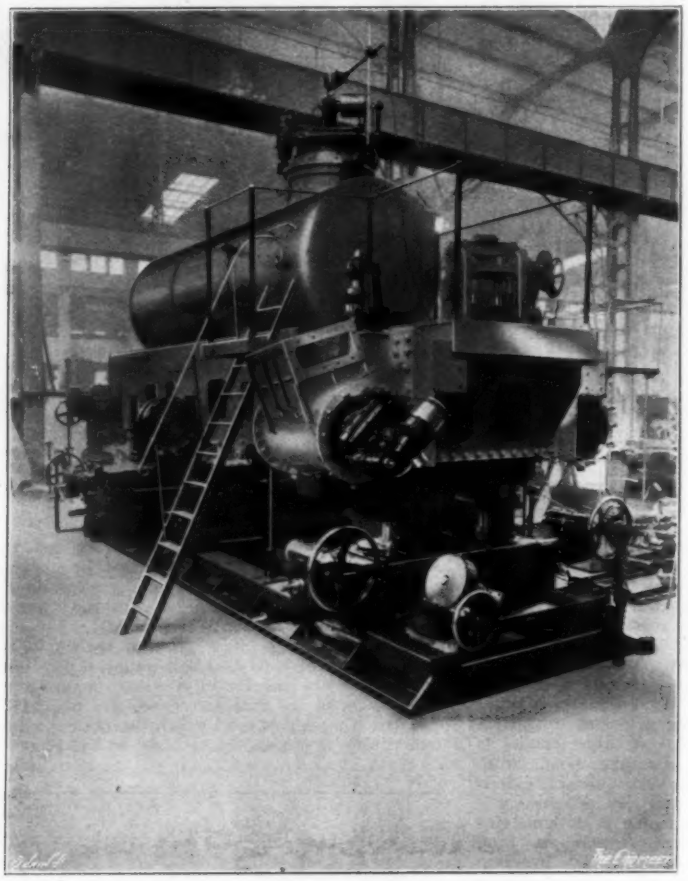

FIG. 8—PORTABLE GRINDERS FOR LOCOMOTIVE REPAIRS—SCHMALTZ

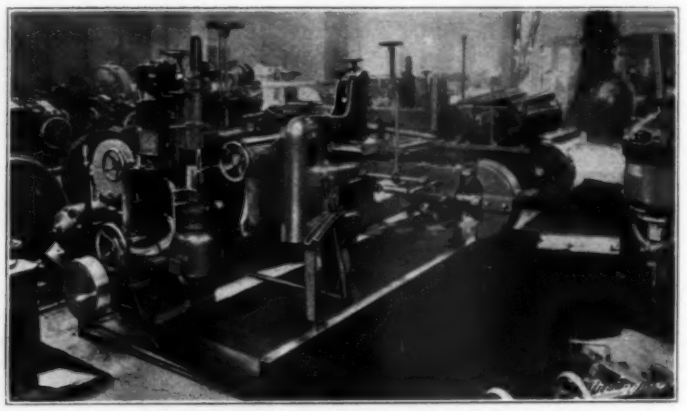

FIG. 9—WOOD PLANING AND MORTISING MACHINE—BOTTCHER

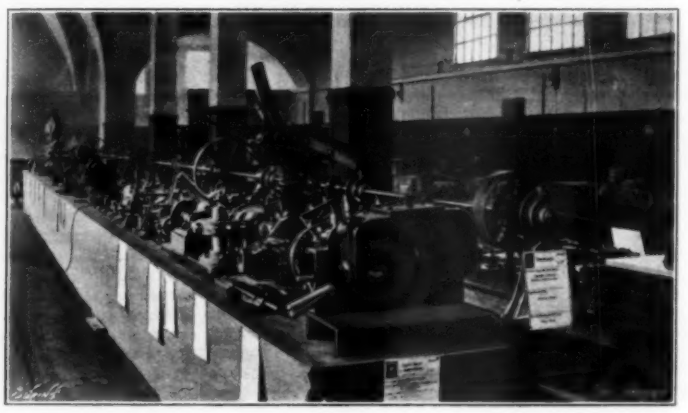

FIG. 10—MODELS OF SPECIAL MECHANICAL MOTIONS

and though the exhausts were nominally taken outside by underground pipes, the fumes, together with those of a number of gas furnaces in the same building, made the atmosphere at times almost unbearable.

Fig. 10 shows one of the exhibits in Hall No. 7, which deserves special mention as it is indicative of the organised efforts now being made to render Germany pre-eminent in technical matters. This particular exhibit, for which the "Ausschuss für wirtschaftliche Fertigung" (the Committee for Economical Production), a body connected with the Union of German Machinery Makers, is responsible, consisted of an extremely interesting collection of examples of special mechanical motions. One saw gearing arranged to draw ellipses or cardioids, curious linkages, and indeed mechanical combinations of apparently every kind ever devised by the wit of man. One was greatly reminded of the some of the galleries at South Kensington, but at Leipzig one could amuse oneself with any model at will. The heavier ones were driven by power to show their action. Not only were the models displayed, but adjacent to every one was a card saying (1) what it was and what it was for, (2) what application it had, if any, and (3) the position of the machine in the Fair where the application could be seen. The educational value of such work is undeniable, as the exhibits not only instructed the visitor, but could not fail to impress themselves strongly and suggestively on every mind gifted with the mechanical instinct.

Space will not permit us to do more than mention the display of building material and builders' hardware with which more than one large hall were completely filled. The electrical exhibits must also be passed over, as for the most part they were concerned with the smaller necessities and luxuries provided by the trade, although in the Electro-technical Hall there were a number of motors, switches, &c., of a heavier nature. Except for about two very small turbines, one oil-fired "locomobile" engine, and sundry valves, fittings and boiler-house instruments, steam plant was almost entirely unrepresented. The heavy-oil engine, on the other hand, held the field so far as prime movers were concerned. Besides the scores of engines shown for their own sake, there were

The Institute of Metals.

No. II.*

THE second paper taken was one by Dr. Max Haas, in which improvements in the Oberhoffer-Esser dilatometer are described.

Colonel N. T. Belaiew said the method discussed in the paper was not very much in favour now, although it was used considerably in the early days. Nevertheless, it was pleasant to see a growing interest in it. It was very important to be sure that there were no allotropic changes in aluminium, but it seemed now to be accepted, as the result of work similar to that described in the paper, that there are no such changes.

Mr. H. Sutton, referring to the use of silica push rods in dilatometric work, asked the author if he had experienced any dilatometric effect on them manifesting itself in the curves.

Dr. Marie Gayler said the paper provided another method by which solid solubility could be determined with greater accuracy than before. It would be interesting to see some application of this work to the study of the ageing of alloys because it appeared that this method would teach a great deal about the mechanism of age hardening.

The first paper to be taken on Wednesday afternoon, March 7th, was one entitled "The Thermal and Electrical Conductivity of Some Aluminium Alloys and Bronzes," by Dr. Ezer Griffiths, F.R.S., and Mr. Schofield. The authors' abstract runs as follows:—

CONDUCTIVITY OF ALUMINIUM ALLOYS.

Two groups of alloys were investigated: (1) those rich in aluminium, with nickel, magnesium, iron, zinc, manganese, or silver as second or third constituents; (2) those rich in copper, with tin, zinc, lead, manganese, or aluminium. The aluminium alloys were found to possess a thermal conductivity of roughly 70 to 80 per cent. that of pure aluminium, whilst the bronzes range from one-fifth to one-tenth of the value for copper. In contrast with the pure metals the alloys all give considerable increase of thermal conductivity with temperature.

A comparison of two bronzes of identical composition, except for the presence of a minute amount of phosphorus, shows that the latter produces a marked lowering of the thermal conductivity. The lowering of the conductivity of copper owing to an admixture of 10 per cent. of aluminium is comparable with that due to the same amount of tin. Of the aluminium alloys tested, the 8 per cent. copper and the 4·5 per cent. copper showed the highest conductivity, amounting to 82 per cent. that of pure aluminium. The lowest thermal conductivity of the series was given by a 13 per cent. zinc, 3 per cent. copper alloy, which had a conductivity of 64 per cent. aluminium.

The ratio of the thermal to the electrical conductivity in the range 80 deg. to 300 deg. Cent. obeys Lorenz's law with one or two exceptions.

The President, having unsuccessfully called for comments on the paper, said it was perhaps not surprising that there should not be much discussion on a contribution of that nature. It was one of those cases of accurate physical determination on which there was very little to be said except by expert physicists. Metallurgists were content to take the data and accept them as amply accurate for their purpose. The existence of the Lorentz constant and the fact that it varied from one group of alloys to another was interesting, more from the point of view of the theory of electrical conductivity than from the practical point of view, but it certainly was a satisfactory result. He only wished that it had been possible for Dr. Griffiths to be provided with a sufficient quantity of the high-purity American aluminium which was still available only in small quantities, in order that the figures might be checked.

The next paper was one on "Season-cracking of Small Arms Cartridge Cases during Manufacture," by Major F. S. Grimston, which was read by Dr. Moore, of the Woolwich Research Department.

SEASON-CRACKING.

A short history of the failure of small arms cartridge cases in India during the past twenty-one years is given, together with a description of a number of experiments which ultimately led up to the discovery of the probable cause. In 1913 certain experiments were carried out, but without producing any important results. A recurrence of the defect in 1924 necessitated another series of investigations. A short description of the important operations on the brass case and drawings of these operations are given. Until recently burst cases have been attributed to inferior metal, but it is shown from these last experiments that the defect can be reproduced by certain combinations of the tools used in the drawing operations. Season-cracking in the walls of the case takes place during the interval between a drawing operation and the subsequent annealing under certain conditions. The conditions are:—

(a) The existence of differential stresses in the case wall caused by tools of wrong design.

(b) Storage of the unannealed cases in contact with soapsuds which have become contaminated with dilute sulphuric acid used in the cleaning processes.

The first portion of this paper deals with the attempts made to ascertain the existence of internal stress by inducing season-cracking by means of chemical action.

The second portion describes certain methods used to detect surface tension in the walls of the cases by measuring the con-

* No. I. appeared March 9th.

traction which takes place after removal of the inner supporting metal. Certain definite conclusions are reached. Illustrations are given of the dies used and of cases showing season-cracks produced in the manner described in the paper.

Dr. Moore, opening the discussion, mentioned that the author had been directing the manufacture of small arms ammunition in India for some years, and although he was in this country for some months a short while ago, he had had to return to India; but, having discussed the paper with the author, Dr. Moore had undertaken to present it. Speaking generally on the paper, Dr. Moore said that internal stresses could be very considerably controlled by attending to the type of cold work put on the brass.

Mr. A. H. Mundey said it appeared to him, to use factory language, that the author had simply "asked for" many of the failures he had referred to because they appeared to be due to serious over-stressing of the material, storing cartridge cases in unsuitable conditions, and pickling them in unsuitable materials, or at least having them unclean. He could not understand why soapsuds and sulphuric acid should have been used, since such a mixture must have been very trying to a material which already had microscopic initial cracking. Even if the sulphuric acid was very weak, there must have been a considerable amount of free fatty acid developed during the decomposition of the subject by the sulphuric acid, and that fact did not appear to have been considered. Anyway, the investigation had been most useful in showing where several factories had been making mistakes for a long period, and it should be of value to the Services. The conical tools used seemed to have stressed the material very much more severely than the bell-mouthed tool, the pickling seemed to have been very much too severe, and storage in many cases did not appear to have been as satisfactory as it should, the latter probably being a question of native want of care.

Colonel N. C. Belaiew said that whilst some of the conclusions in the paper were self-evident, he could not endorse what the author said about the quality of the material not being of so much importance as the drawing operations. In his opinion, the results obtained all depended upon the quality of the tools and how they were being used, and how the whole work was organised. The wise works manager would always see that the mean quality of the material supplied would give a certain latitude, and that it must not be possible to use different sets of tools in a manner which would give different results. From that point of view, therefore, the quality of the material supplied was not to be despised. Again, the author stated that within certain limits, the annealing, and annealing generally, was not of very great importance; but again he could not support a statement like that, because even twenty or thirty years ago it was appreciated that not only was the temperature of annealing of some importance, but the time of annealing also. Experience had shown that when annealing temperatures were the same, different results were obtained according to the material and time of annealing, and the statement by the author to which he had referred might be a little misleading.

Dr. H. W. Brownsdon stated that properly studied the paper should lead to very considerable improvement in the technique of drawing operations in general, for even now engineers were not producing brass cases in the Services which had a quite neutral point, so far as the equilibrium between internal stresses was concerned. That was illustrated by the fact that they must be submitted to low-temperature annealing when finished, from which it was only possible to draw the conclusion that they were already in a state of internal stress, which was likely to lead to trouble. The author had limited himself to the consideration of the third draw, but if he had gone through the other products from the cup onwards, he would probably have found that all the products were in a state of tensional stress likely to lead to season cracking up to a certain point. If the final drawn product was still liable to develop seasonal cracks it should be subject to a heading operation, which the author did not refer to, otherwise there would still be dangerous internal stresses. When the tensional stresses were neutralised by compression stresses, the product was no longer in the dangerous state in which it otherwise might have been. He wished the information in the paper had been available seven or eight years ago when he was dealing with the problem. It was difficult to understand some of the author's results, especially the corrosive effect of his acids and soapsuds mixture, but he would leave that point for discussion by one or two of his colleagues, who, since the paper was published, had had an opportunity of carrying out a little experimental work in that connection.

Mr. James Fox said that although in papers on season cracking the question of internal stresses was always mentioned, yet those stresses formed a very small part of the actual investigation. The question of the dies was an important one, because it was impossible to go on indefinitely work-hardening, either non-ferrous metals, steel or pure metals, without imparting to them something which would have an injurious effect unless steps were taken to check it. The question of internal stresses had really largely been neglected, and from investigations which he had made he was of the opinion that if the whole phenomenon of season cracking was studied from the standpoint of internal couples—*i.e.*, the sum total of all the stresses inside the tube instead of one single stress—he believed that the solution of the phenomenon of season cracking and similar effects would speedily be solved to the satisfaction of the trade in general.

Mr. W. H. Craven discussed the design of dies and also the residual stresses in the products, in relation to which he had carried out a number of experiments, the results of which he showed on curves. Many of his results were substantially in agreement with the author's conclusions, but others showed differences.

Mr. F. Dickenson (Woolwich Research Department) said he was interested in a point made in the paper that sulphuric acid solution acted as an accelerator in promoting season cracking of highly stressed brass, and he had carried out some experiments to determine whether brass in a state of severe stress would crack if stored in the presence of diluted sulphuric acid solutions. Tests had been carried out upon two makes of 70 : 30 brass tubes, ¾in. external diameter and ·057in. thick. When tested with mercurous nitrate solution longitudinal cracks occurred in specimens of both tubes during immersion or very shortly afterwards, one make of tube having wide gaping cracks indicating the presence of internal stresses of a high order. Specimens were then stored in test tubes and also in wooden boxes in contact with sulphuric acid of two concentrations, one part of sulphuric acid to 20 parts of water and one part to 100 parts of water, the specimens being cleaned in acetone before storage, there being also a preliminary pickling. The specimens stored in the glass test tubes were first dipped in the various solutions and a small quantity of the solution was placed in the tube, the specimens were completely immersed in some cases and partly immersed in others. One hundred and twenty specimens were stored under those conditions for ten days, and although there was severe pitting in the specimens partly immersed in the sulphuric acid solution, ordinary visual inspection had so far failed to find any season-cracking in any of the specimens in the glass tubes. The other specimens were placed in wooden boxes and the solution was poured over them. This solution soon soaked into the wood and evaporated, but after a few days' storage a further quantity of solution was poured on the specimen in the same way. Forty-eight specimens were treated in that way, and at the end of ten days six of them showed distinct season-cracking. That occurred only in one make of material, but it was interesting to know that that particular make gave much less severe cracking than the other make when tested in the mercurous nitrate solution. Some of the specimens in the test tubes were taken out and expanded in the manner described in the paper, but the expanded specimens did not show any cracks. Storage tests, however, on a larger scale were being arranged.

Mr. J. B. Nevitt said that one point overlooked was that the cracks found by the author might have been caused through the action of mercury in the caps through stresses which had not been removed by subsequent operations. He had come across that effect in cartridges, stored in the Tropics, when everyone had burst under the head on firing, as described by the author. As regards the effect of sulphuric acid mentioned by Mr. Dickenson, he had not found that cracking occurred in the manner suggested. He had gone farther and hung specimens in the mouth of annealing muffles, where there was a chance of ammonia being in the atmosphere, but the results were still negative from the cracking point of view. Eventually the trouble was put down to the fact that the cases became contaminated with mercury from a machine used for decapping and when that was avoided the trouble ceased. Therefore, before accepting the suggestion that sulphuric acid would cause season-cracking, every care should be taken to see that there was no possible contamination of any of these products with mercury or ammonia.

The author will reply in writing.

A paper entitled "Historical Note on Density Changes Caused by Cold Working of Metals," by Mr. Hugh O'Neill, was then read.

There was no discussion.

The next paper was one on "The Ball Hardness and the Cold Working of Soft Metals and Eutectics," by Mr. F. Hargreaves.

BALL HARDNESS.

In this paper it is shown for a number of soft metals and eutectics that the relation between diameter of impression and duration of loading is given by the equation $d = c\,t^s$, where d = diameter of impression, t = duration of loading, and s and c are factors which vary in certain ways. Temperature of testing is of great importance, and the total inadequacy of the Brinell hardness figure as a general method of expressing the hardness of soft metals is demonstrated. It is suggested that the ball hardness of soft metals be expressed as in the following example:—Tin (10 mm./100 k.g./30 secs./15 deg. Cent.) Brinell hardness 5·3 s = 0·050.

The effect of rate of loading is briefly considered. It is found in all the cases examined that the effect of work is to increase the factor s, and it is suggested that in the case of pure metals it is a measure of the rate of spontaneous annealing. The work softening of some eutectics is investigated, and it is shown in the case of the lead-tin eutectic that the rapid fall in Brinell hardness between 20 and 30 reduction in thickness is coincident with the rapid increase in the rate of spontaneous annealing of the main constituent, tin.

Mr. A. H. Mundey said the paper had shown that cold work on soft metal eutectics did tend to soften, and it was perhaps a little alarming from some points of view. Mr. Hargreaves was a railway metallurgist, and there was a considerable amount of fatigue in white bearing metals which were being used on railways. The moral of the paper seemed to be that such bearings continually subjected to hammering in service were being slightly softened. That was a rather alarming prospect to the user as well as to the maker of white bearing metal. The paper seemed to leave no doubt that the time factor was a very important one and that soft metals gave varying results according to the method of hardness testing and the length of time the specimen was being stressed and strained.

Professor D. Hanson welcomed the paper, not so much for the added information which it gave with regard to the Brinell test, but as a contribution to knowledge of the deformation of metals under, perhaps not prolonged, but rather more lengthy applied loads than were usual. The work might also throw some further light on the behaviour of metals under what was called creep conditions, and from that point of view he hoped the author would continue the work under longer loading times than he had done.

Mr. H. O'Neill said that one could hardly be expected to get rational tests when studying cold work at relative temperatures such as those used by the author, because in the case of copper at about 600 deg. the effect of deformation was not to increase the hardness to any extent at all. In connection with Brinell tests on the lead-tin eutectic it had been proved that lead and tin harden at room temperature and yet the eutectic of the two metals did not. The really important matter was the melting point, the eutectic having a lower melting point than that of the two metals. He did not think that a single Brinell number could be taken as a criterion of hardness under the conditions outlined in the paper, and therefore he regarded the chief use of the interesting work described to be in the study of creep phenomena.

The President said that whilst the melting point was a thing that mattered, there was something else, namely, that the mode of deformation of a eutectic appeared to be essentially different from that of pure metal. The deformation with pure metal was a slipping of the cleavage planes of the crystals, but in an eutectic it was mainly on the boundaries between the laminæ, in a laminated eutectic. What happened in a eutectic in which a laminated structure did not exist, he did not know at present, although there were varying reasons which had been developed elsewhere to explain what should happen. The effect, however, was very different according to whether the deformation occurred at a temperature where the metal was very soft owing to nearness to the melting point, or whether it was a comparatively long way off the melting point. In both cases the eutectic appeared to behave differently from the constituent metals, although the mutual solubility of the two was very small in the case of lead-tin and appreciable in the copper-silver alloys.

Mr. Hargreaves, replying to the discussion, said he did not agree that softening in the case of an eutectic had anything to do with the melting point. Experiments were still in progress, and he believed that it would be found eventually to be due to non-recovery from work.

A paper by Mr. W. L. Kent on "The Behaviour of Metals and Alloys During Hot Forging" was then presented by Dr. Hanson, owing to the illness of the author.

HOT FORGING.

Small cylindrical specimens of pure metals and some brasses were forged with a standard blow of 50 foot-pounds at temperatures up to the melting points, and the mechanism of hot forging was investigated by measurements of the degree of compressions produced and by comparison of the Brinell hardness values so obtained. The following conclusions are drawn:—

(1) That although the forging test does not measure the malleability of a metal or alloy, it will indicate the relative forgeability at different temperatures, and also the liability for cracking to occur during the operation. It appears that if the working properties of a metal or alloy are to be determined by ordinary mechanical tests then the joint results of forging and notched bar impact tests will give the best approximation to the truth.

(2) When a metal is worked at elevated temperatures it strain-hardens in much the same way as at normal temperatures, but not to the same extent. The degree of strain-hardening in copper decreases progressively, but very slightly, as the temperature is raised to 550 deg. Cent.—recrystallisation commenced at 600 deg. Cent. and was complete at 650 deg. Cent.

(3) That continuous hot forging is in some cases made possible by the very rapid recrystallisation and consequent softening of the material, as, for example, copper; but in some cases the actual softness of the metal at elevated temperatures is an aid to hot forging, as, for instance, aluminium, where rapid recrystallisation does not occur and there is a residual hardness even after forging at 650 deg. Cent. The progressive decrease in strain-hardening postulated above for copper is probably greater in the case of aluminium.

(4) The forgeability of 70 : 30 brass increased but little up to 750 deg. Cent., but that of 60 : 40 brass increased steadily between 400 deg. Cent. and 600 deg. Cent., and very rapidly from that temperature to the melting point. The presence of lead caused cracking from 350 deg. Cent. upwards, but in 60 : 40 brass the cracks disappeared at 700 deg. Cent., and the material containing lead produced a better forging than the pure alloy.

Mr. R. Genders showed a number of slides illustrating some recent work done by Doerinckel and Trockles on the subject dealt with in the paper, which, he said, he had been using in some lectures on the matter.

Dr. H. W. Brownsdon said the forging properties of metal were definitely associated with the size of the specimen. A large specimen would forge very much more rapidly than a smaller. Incidentally he expressed the wish that the author had used for his experiments materials which were used in practice.

In the case of hot forging of brasses, according to whether extruded or case metal was used, so the results would differ. The crystalline structure of extruded metal was likely to be very different from that which was rolled or cast, and it would be more interesting to have had the experiments carried out on a marketable product. He assured the Institute that industrialists would be only too willing to help investigators to carry out work which had a definite practical application, and if Mr. Kent had brought the matter to his notice there would have been no difficulty in supplying him with material such as was used in practice, the results from which would have added considerably to the value of the paper. The lead-tin alloy of the nature referred to in the paper was not an alloy to be found in extruded material used for hot forging, and the specification usually specified it to 1½ per cent. of tin instead of ½ per cent., as in the author's case.

The meeting then adjourned until Thursday, March 8th.

On Thursday, March 8th, a paper by Mr. G. L. Bailey on "The Influence of Dissolved Gases on the Soundness of 70/30 Brass Ingots," was the first to be presented.

DISSOLVED GASES IN BRASS INGOTS.

The work described had the object of determining whether unsoundness could be induced in 70 : 30 brass ingots by treating the molten metal with various gases before pouring. Preliminary experiments on bronze—an alloy known to be susceptible to gas effects—showed that treatment with nitrogen gave an ingot practically free from unsoundness owing to gas. Comparative tests were made on samples of 70 : 30 brass treated with nitrogen, hydrogen, and sulphur dioxide, poured in a series of moulds giving different speeds of solidification. No evidence was obtained in any of the treatments of unsoundness in the ingots caused by gas evolution during solidification. It is concluded that if appreciable amounts of gases are soluble in liquid brass the solubility in the solid state is sufficiently high to retain the gas in solution. The probability is, however, that the high vapour pressure of zinc in molten brass precludes the solution of gas by the alloy.

Mr. J. Cartland, referring to Mr. Bailey's statement that Guilleman and Delachanal, on evacuating a silica tube containing brass, inserted in a coke furnace, at about 1000 deg. Cent., had obtained gases up to seventy times the volume of the specimen, said that whilst that statement was true, it was a little misleading, because it conveyed the impression that those workers had frequently obtained volumes of gas of that order. That, however, was not the case. In his own work, the results of which were not published, he had found on heating a 60/40 brass in vacuo that the volume of gas was from 0·3 to 0·84 times the volume of the metal. The gas he had obtained had contained about 60 per cent. of hydrogen. He had found no evidence connecting the volume or nature of the gases obtained with the soundness or otherwise of the castings, and the work of Mr. Bailey seemed to show that possibly there was no such relation.

Mr. H. C. Dews said that Mr. Bailey had assumed that in the case of brass and bronze, the nitrogen would eliminate any dissolved gases, but that assumption required a good deal of experimental proof. As a matter of fact, the paper contained direct proof that the nitrogen did not eliminate furnace gases in bronze, for a reference was made to a sample of bronze being melted in a salamander crucible in an ordinary furnace and nitrogen passed through it, and it was still unsound. He emphasised this point about nitrogen treatment, particularly because the paper was supposed to make an appeal to the practical man and the treatments described were supposed to be capable of immediate practical application, but it was rather important that manufacturers should not be encouraged to flirt with a treatment of that sort, which was expensive, inconvenient, and, as far as was known at present, not definitely reliable.

Dr. Max Haas emphasised the practical importance of nitrogen treatment, particularly in the case of bronze. In Germany, he said, with coal dust fired furnaces, pyrites had been introduced, and SO_2 was formed, and the nitrogen treatment had had good results in eliminating these noxious gases. The *rôle* of SO_2 in bronze was similar to the *rôle* of oxygen in steel. Dr. Haas expressed the view that in a few years nitrogen treatment would be adopted on a large scale, and that that method would be used in the casting of special bronzes.

The President said he believed that the action of nitrogen was fairly clearly understood. The explanation was very general, and it applied to the relationship between gases and liquids everywhere. It was that if one had a gas dissolved in a liquid the amount which would be retained by the liquid depended upon the partial pressure of the gas in immediate contact with the liquid. By passing an inert gas—if there were such a thing—through a metal, one swept away the other gas to the extent of reducing the partial pressure locally to a very low value, and so far as that particular dissolved gas was concerned, the effect was identical with the production of a vacuum. For that reason the dissolved gas, if really dissolved and not combined, was bound to be taken out. One could demonstrate that effect in the case of a metal—any metal which did not form definite hydrides and nitrides—by saturating it with hydrogen and blowing nitrogen through it, when it was found that the nitrogen came out of the metal containing a large percentage of hydrogen—so large that it would catch fire at the top. It did not follow, of course, that because that phenomenon happened in certain metals it was bound to happen in all, for in some cases there might be dissolved gas not in the ordinary state of solution, in equilibrium with an atmosphere, such as partial pressure, but in more or less loose or firm chemical combination, and therefore in a form in which it might be retained. Neither did it follow that, because it was in the state of combination, it might not be liberated or might not affect the density of the resulting solid. He would have liked to have seen an attempt by the author to determine the effect of pre-solidification on density, *i.e.*, the expelling of the gases, gradual freezing, then re-melting as quickly as possible and recasting. That would have given, at any rate, a basis figure which would have been interesting for purposes of comparison. There was no doubt that the whole question of gas inclusions in metals was only beginning to receive attention, and metallurgists were only just commencing to develop a technique not only for their removal, but also for their accurate estimation.

Mr. Bailey, replying to the discussion, said the President had kindly answered for him Mr. Dews' question as to how the nitrogen treatment could eliminate dissolved gases, and it followed from that explanation that the nitrogen must be in large excess. It must be practically the sole atmosphere over the metal. Whilst he believed that we could thus expel dissolved gas from the bronze, he did not make any definite recommendation to bronze manufacturers. A point overlooked by Mr. Dews was that Professor Edwards, or those working with him at Swansea, had also used the treatment with very great success on pure copper, and the work done there on pure copper provided the answer to the President's question as to why he (Mr. Bailey) had not tried pre-solidification. He had tried to include actual density figures in his tables, but they confused the issue.

Dr. A. L. Norbury then presented a paper on "The Effect of Quenching and Tempering on the Mechanical Properties of Standard Silver." We give the author's summary.

THE MECHANICAL PROPERTIES OF STANDARD SILVER.

Standard silver (92·5 per cent. silver, 7·5 per cent. copper) as ordinarily annealed contains a considerable amount of copper—in which some silver is dissolved—distributed in the form of small particles throughout the silver solid solution matrix. By suitable heating—*e.g.*, about half-an-hour at 770 deg. Cent.—and quenching these copper particles may be dissolved and retained in supersaturated solid solution in the silver. On tempering quenched specimens structures reminiscent of martensite, troostite, and pearlite are obtained—the as-quenched a solid solution structure being similar to austenite. The "martensitic" structure is the hardest and least ductile. The alloy when in the quenched condition is about 30 per cent. softer and 20 to 30 per cent. more ductile than it is when in the as ordinarily annealed condition.

On suitable tempering the quenched alloy, *e.g.*, about half-an-hour at 300 deg. Cent.—its Brinell hardness increases by about 300 per cent. and its tensile strength by about 50 per cent. At the same time its ductility falls by about 50 per cent. These effects are due to the decomposition of the supersaturated solid solution of copper in silver. The hardening on tempering is accompanied by a decrease in volume. The hardening obtainable by tempering is uniform, and is consequently superior to the hardening obtainable by rolling, stamping, and similar operations where the hardening is not uniform and sets up stresses and strains in the alloy. It is possible to harden the quenched alloy by cold work and then further harden it by suitable tempering. On cold working specimens tempered at different temperatures, and consequently of greatly different hardnesses, they tend to become equal in hardness as the amount of deformation is increased. The alloy is more resistant to oxidation and tarnishing when in the quenched and tempered conditions than it is when in the annealed condition.

Mr. A. R. Powell said his firm had carried out a considerable amount of research on silver during the last three or four years, and whilst it had not actually produced the same effects as Dr. Norbury, it had found that by annealing at from 600 deg. to 700 deg.—the temperature had not been taken beyond 700 deg. because it was under the impression that the eutectic would melt—and then quenching, there was a very considerable softening effect as compared with the effect produced by slow cooling. He asked if Dr. Norbury had investigated the effect of leaving tempered specimens for various periods of time at temperatures of 100 deg. or more. It appeared that hardness increased in half an hour at 100 deg., and he asked what would happen in a few days. The people who bought silver expected to be able to work it, and if its hardness suddenly rose from about 50 to 130 Brinell, there would be complaints.

Mr. W. A. C. Newman joined with Mr. Powell in a mild protest against the use of the term "tempering," as Dr. Norbury had used it, because in this case it had an opposite meaning to that which it had in the ferrous industries, and there was a likelihood of undesirable confusion. It was interesting to note that Dr. Norbury's results confirmed some of the results obtained by Frenckel.

Mr. W. G. Turner discussed the possibilities of salt bath annealing, and urged that it was well worth while studying the problem of its improvement and its application on a large scale.

Professor C. H. Desch, F.R.S., said that to the steel metallurgist the interesting point was the close analogy between steel and the system dealt with by Dr. Norbury, and he defended Dr. Norbury's use of the word "tempering" because the changes that occurred in the tempering of silver as described in the paper were exactly the changes which occurred during the tempering of a quenched steel. The experience with steels went to show that the structures obtained by tempering at temperatures of 250 deg. or thereabouts were stable at ordinary temperature for a very long time—practically indefinitely—and one ought to be able to obtain standard silver with a very wide range of mechanical properties which would vary according to the particular purpose for which it was to be used.

Professor D. Hanson said that there could be no doubt, from the paper, that not only the annealing but the whole heat treatment of standard silver had been placed on a proper scientific basis, and those who were handling that material would be able to deal with it in a way in which they could not have dealt with it before. He did not think that they had had any idea of the immense possibilities of the treatment that had been indicated by Dr. Norbury.

Dr. Norbury, in a brief reply to the discussion, referred first to the question of nomenclature. He had always associated age-hardening, he said, with the change that occurred through the passage of time without the application of heat, and he had used the word "tempering" because, as Professor Desch had pointed out, the changes were similar to those which occurred in the tempering of steel. If, however, the word "tempering" were applied already to other changes that occurred, it was possibly better to use the term "age-hardening." He had read Frenckel's paper only after his own manuscript had been sent to the Institute.

A paper by Dr. Friend and Mr. Thornycroft, on "An Example of Roman Copper Soldering and Welding from Uriconium," was taken as read, and a paper by Dr. Friend, on "The Relative Corrodibilities of Ferrous and Non-ferrous Metals and Alloys," Part 1, was presented by the author.

THE CORRODIBILITIES OF FERROUS AND NON-FERROUS METALS.

Fifty bars of ferrous and non-ferrous metals were exposed to sea action in the Bristol Channel for four years, and an account is given of the fourteen non-ferrous bars. Losses in weight, depths of pitting, reduction in diameter, and fall in tensile strength in consequence of corrosion are correlated. The metals examined included tin, lead, nickel, zinc, aluminium, and various coppers and brasses. Nickel, tin, and lead resisted corrosion remarkably well. Of the brasses, screw metal (1·37 per cent. lead) made the best showing. This was closely followed by the nickel-copper (1·75 per cent. nickel). A galvanised iron bar lost less in weight than either the iron or the zinc separately. The aluminium bar was very deeply pitted. Dezincification of the brasses is discussed. The relative rates of corrosion of ferrous and non-ferrous metals and alloys are compared.

Mr. U. R. Evans said that Dr. Friend's careful and patient work on the slow corrosion of metals and alloys in the sea would be greatly welcomed by practical men, who would often turn to his results when in doubt as regards choice of materials. It was to be hoped, however, that they would not overlook the author's wise warning that it by no means followed that the metals would exhibit the same relative corrodibilities if exposed under different conditions. Whether or not they would be able to judge, even approximately, the effect of the difference in conditions as between the Bristol Channel and the place where the materials would actually be used must depend mainly on whether the practical men who had to make the choice possessed a scientific understanding of the mechanism of corrosion. Indeed, in considering any paper of this character the conclusion was invariably reached that the data would only prove really useful if used by men who realised how and why corrosion proceeded. It was a matter of vital economic importance that the elements of the subject should become widely understood and should be regarded as an essential part of an engineer's training. Dr. Friend's attitude to the more recently adopted theories remained rather ambiguous, and consequently it was impossible truthfully to assure engineers that agreement was reached; until they were convinced, however, that some finality had been reached they would not be persuaded to tackle an unfamiliar and somewhat difficult subject. For that reason it was highly desirable that Dr. Friend should define his position regarding the views of corrosion developed in recent years. In view of the enormous money losses suffered annually through corrosion, there could be no possible excuse for the continued exclusion of that subject from engineering courses, other than that we did not know enough about it.

Dr. G. D. Bengough said that a criticism which applied to that paper, as to many others—including some of his own past work—was the difficulty of interpretation, and if we could not interpret results in a fairly strict manner we should be piling up large quantities of data which we were rather afraid of using. The paper purported to give a direct comparison of the relative resistance to various types of corrosion manifested by certain ferrous and non-ferrous metals exposed to sea water, the conditions of exposure closely resembling those to which metals on the exposed parts of ships and other marine structures were subjected. That was a very desirable objective, of special interest to non-ferrous metal people, because they must demonstrate the superior resistance to corrosion of their products, or die. But that objective was quite beyond the reach of work of that kind, as the author appeared to have realised, for, whilst he had given figures of merit for the non-ferrous metals, he had avoided giving figures for the ferrous materials. Further, he had said that the figures given indicated the "apparent" order of merit, and presumably the word "apparent" was used because he could not give the true order, which was rather a serious flaw. The author had

uttered a caution as to the way in which his results were to be interpreted, and that caution must be observed to such a very large extent that it excluded the placing of any important interpretation upon the results if one were attempting to design structures with those metals. Corrodibility was not a property of the metals themselves, as was specific gravity, and so on; it was the net result of two sets of factors, one relating to the metal and one to the conditions. The set of factors relating to the metal were known, but not the others, and experiments in which both sets of factors were known were wanted. Then progress could be made along both theoretical and practical lines. The confidence of the practical man would not be gained until more knowledge of that kind was available.

Mr. J. C. Hudson emphasised the desirability of conducting tests on a reasonable number of duplicate specimens, not only because of the unavoidable and often inexplicable differences that might be observed between two apparently similar specimens, but also because, when comparative results were sought for a number of different materials, and it was necessary to expose a large number of specimens side by side, it was not easy to ensure that all the specimens were exposed under equivalent conditions. He hoped Dr. Friend would be able to include tests with duplicate specimens, for, although that would entail a great deal of work, it would be well worth while. That might perhaps be done by halving the diameter of the bars which would give four specimens from the same mass of material. It might also be advisable to increase the clearance between neighbouring bars, for there was always a tendency for one bar to shelter a neighbouring bar.

Colonel N. T. Belaiew, emphasising the importance of giving careful consideration to the corrosive properties not only of the principal material used in a structure, but also of the materials used in contact with it, related the story of an American millionaire, who, although he had had his yacht constructed of special non-corrodible material, had found that in a few weeks, or perhaps even a few days, it was unseaworthy, because the rivets used were of different material and violent corrosion had resulted. The same moral could be derived from Dr. Friend's experiments, because under the conditions in which his experiments were carried out the corrosion was rather different from that which was usually expected.

Dr. Newton Friend, replying to the discussion, reminded Dr. Bengough that the conditions under which the bars were exposed were identical with those which obtained at the point at which the pier at Birnbeck had corroded most seriously, and if it were correct that the metals he had dealt with could be classified into the poor, the good, and the intermediate, then he suggested that the research had not been altogether a failure. He agreed with Mr. Hudson that the position of the bars was important, but pointed out that Mr. Hudson's specimens were exposed for only a few days, so that even the prevailing wind or a change of temperature would have an effect, whereas his own experiments had extended over four years, and one would expect the variations in conditions to balance one another in that time. He would have liked to have had other sets elsewhere, but the work was very expensive; but the specimens at Southampton, together with those referred to in the paper, should yield some very interesting results. Dr. Friend intimated that he would reply to the discussion more fully in writing.

A paper by Dr. Allibone and Mr. C. Sykes, on "The Alloys of Zirconium," was then read and discussed.

The meeting concluded with the usual votes of thanks.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

COMPENSATED SPRING GEAR ON LOCOMOTIVES.

SIR,—Although so situated that a letter referring to a discussion in THE ENGINEER may fail to be topical on its arrival, yet I consider it necessary to comment on the rather remarkable letter from "Ex-Driver" on the above subject appearing in your issue of December 9th, 1927.

Every locomotive engineer responsible for the service of locomotives over sharply curved and difficult tracks, and for that matter civil engineers in charge of the permanent way of such lines, know that for safety in cases where locomotives are called upon to pass over the minimum curves which they are designed for and can theoretically pass, it is indispensable to have the springing compensated.

The writer, apart from continuous observation and proof of this fact in everyday working, made tests with locomotives in such circumstances and actually had practical demonstration of how a soft place, or lack of superelevation in a section of the outer rail of a curve, will produce a derailment of an uncompensated locomotive when the extreme wheel of a rigid wheel base encounters the low place, whilst a similar engine with compensating levers will not derail. The reason for this being, of course, that with the uncompensated gear the wheel passing over the low place loses some of its imposed weight, whilst with compensating beams the calculated weight distribution is very closely maintained.

If further proof were needed the writer may say that he has had locomotives unprovided with compensation which previously gave continuous trouble by derailments on curves, but which were completely cured of the habit by the addition of compensating beams in the spring gear.

All this is apart from the much easier riding of locomotives equipped with compensating gear, which, in my experience, has always been the case, and this naturally lessens shocks and wear on the track.

It is correct that a locomotive running at the higher speeds has more tendency to "lay-over" to the side where a low place in the track exists, when fitted with compensating gear than one without such gear, and this would naturally be most evident in locomotives in which a specially large proportion of the length of wheel base was interconnected by the compensation system, but this is of minor importance compared with the question of exemption from derailments.

It may be that the tendency referred to in the previous paragraph has caused the impression which "Ex-Driver" has of the behaviour of locomotives provided with compensated spring gear.

For the higher speeds I should consider that not more than two adjacent pairs of wheels should be compensated together.

P. C. DEWHURST, C.M.E.

Bogota, February 9th.

SOUTH AFRICAN LOCOMOTIVES.

SIR,—With reference to your South African Engineering Notes on page 249 of last week's issue and your reference to German tenders accepted, I might say that what is stated is not exactly accurate. The "15C" class has never been built in Great Britain—it was originally built by the Baldwin Locomotive Company, and has since been built by the American Locomotive Company. The "15th" and "15A" classes have been built in England by the North British Locomotive Company and Beyer, Peacock and Co., but these are plate-frame engines, whereas the "15C" is a bar frame, and to all intents and purposes, a different design (different cylinders and boiler and tender).

I submit that it is not exactly true to say that Germany has supplied all the experimental engines. The "G.C." class, built by Krupps, and the "G.D." class, built by Linkehofmann, are identical with the original Beyer, Peacock locomotives, except for having bar frames and grease lubrication. Even in the case of the "G.H.," built by Maffeis, and the "G.F.," built by Hanomags, a set of Beyer, Peacock drawings was supplied as a basis.

All the experimental Garratt locomotives may be said to have been built by Beyer, Peacock, including 54 Garratt locomotives of twelve different types, and Germany has merely obtained orders for the demand for this type of locomotive created by the success of these 54 engines.

It might interest you to know that the large 186 ton Garratt was submitted by Beyer, Peacock and Co., to the South African Railways for working the Union Express, but a cut price from the Germans took it from us and they have built the engine to our drawing.

During latter years German locomotive firms generally have laughed at the Garratt locomotive, and one firm has even printed in one of its pamphlets remarks ridiculing the type, so that it is hardly fair to credit Germany for having introduced the experimental engines. Germany has certainly gained considerable kudos and consolidated her position, but this will only be for a time.

For BEYER, PEACOCK AND CO., LTD.
W. CYRIL WILLIAMS.

London, S.W. 1, March 6th.

A COMPRESSED AIR METER.

SIR,—In your issue of January 20th (just to hand) there appears a letter by John L. Hodgson. This letter contains statements that I am compelled, however reluctantly, to challenge, so that no false impressions may remain.

Mr. Hodgson evidently refers to weighted door meters supplied in 1911 by Geo. Kent, Ltd., to the order of the Mines of the Central Mining-Rand Mines Group, to measure air power supplied by the then Rand Mines Power Supply Company, Ltd., now absorbed by the Victoria Falls and Transvaal Power Company, Ltd. The shaped scoop of the Kent-Hodgson meter is not designed on the principle of the meter described in my paper, and it was to effect an improvement that the new meter was evolved.

The meters supplied by Kents have given satisfactory service for all these years, but it must be remembered that they have been under continuous supervision and test by an expert testing department. Every meter is inspected monthly, and a test on the mechanism carried out and adjustments made, if necessary. Every two years each meter is taken bodily to the test plant, thoroughly cleaned and overhauled and recalibrated against our standard air displacement meter, which has a capacity up to 20,000 cubic feet per minute, and which gives a registration when passing air through a $\frac{1}{16}$in. diameter hole. The above are routine tests. In case of breakdown special attention is immediately given and the meter put right. Certain parts of these meters have been altered and replaced. This care and expense is amply justified, because the cost bill for air power paid on meter registration amounts to about £25,000 per month. There are twenty of these meters in service.

With regard to the remark that the theory advanced in my paper for calculating the dimension of the slot as per Fig. 5 is "futile"—this is simply a bald statement. We have made and are making the meters to formula.

It might be mentioned that in the last few years over £25,000 worth of meters designed on the principles enunciated in my paper have been manufactured in Johannesburg and sold on these fields and are in daily use.

With regard to testing, every commercial meter must be tested and calibrated, no matter on what principle it works, if dependence is to be placed upon its accuracy. I have had some knowledge and experience of metering for the last forty years, but it may be my misfortune not to have seen the water meter made by Geo. Kent, Ltd., twenty-five years ago, referred to in the final paragraph of the letter.

In conclusion, Sir, do not imagine that I wish to indulge in an acrimonious correspondence or waste your space, I simply want to correct wrong impressions and trust you will give this letter equal treatment. Thanking you in anticipation.

E. J. LASCHINGE.

Johannesburg, February 21st.

SIXTY YEARS AGO.

IN our issue of March 13th, 1868, we recorded the death of Monsieur Leon Foucault, member of the Academy of Sciences and of the Bureau des Longitudes, Paris. Monsieur Foucault was, and still is, best known for his demonstration of the rotation of the earth by means of the pendulum. He first exhibited the experiment at the Pantheon, Paris, in 1848, and afterwards showed it at the Great Exhibition in London in 1851. He died prematurely at the age of forty-nine. . . . In another note we mentioned some experiments which another famous French scientist, Regnault, had recently been carrying out. The experiments were designed to test the velocity of propagation of sound in confined passages. For this purpose Regnault made use of the Paris sewers in which he discharged pistol shots and through which he transmitted vocal and instrumental music. According to our account of the results, it was found that the velocity of propagation of sound through the sewers decreased very rapidly with the diameter of the sewers. It was also found, so we stated, that the speed of propagation varied with the pitch of the note, a high note travelling less swiftly than a low note. A tune covering a considerable range of notes would therefore be considerably altered after being transmitted through a confined passage of any great length. It was explained that this musical "decomposition" was not observed in the open air probably because of the absence of the friction which was present in a confined passage and which influenced the rapidity of propagation of the different tones. It is now generally agreed that Regnault was right in his first conclusion, but subsequent experiments have failed to establish the existence of a difference of more than one-tenth of 1 per cent. in the velocity of sounds of frequencies extending from 32 to 640 vibrations per second. . . . The experiments of another French scientist also mentioned in the same issue may be noted here, although they have no direct bearing on either physics or engineering. They were those of Dr. Lemaire on the "multitude of organised beings which exist in the air of hospitals and other ill-ventilated buildings." These "microscopic beings" were, he held, the cause of infection, and it was by their means that disease spread so rapidly. It was shown that these "minute animalcules" could be developed in the bodies of healthy persons when cleanliness was not strictly adhered to. Quite recently, we added, Monsieur Poulet had demonstrated the presence of "infusorial animalcules" in the breath of children suffering from whooping-cough. Our own Lister was not mentioned, although it was as a result of his work, then well on its way to success, that the world owes to-day its enlightened knowledge of the part played by bacteria and bacilli in the generation and spread of disease and of the means that may be taken to defeat their activity.

LIVERPOOL ENGINEERING SOCIETY.

A PAPER entitled "Developments in Steam Turbine Propulsion" was read before the Liverpool Engineering Society on Wednesday last, 14th inst., by Mr. R. J. Walker, M. Inst. N.A. In the course of the paper the author dealt more particularly with improvements and developments that have been effected during recent years. He said that of the total output of turbine propelling machinery for British and foreign-built vessels about 24,000,000 horse-power had been transmitted through mechanical gearing. There was, he said, practically no limit to the ratio of reduction that could now be effected between the turbine and the propeller. The largest ratio of reduction adopted with a single gear was 30 : 1 and with double reduction 60 : 1. Marine geared turbine installations were now under construction to transmit through a single gear horse-powers up to 50,000, with as much as 27,000 horse-power through a single pinion. With recent experience gained in heat treatment of the steel and the cutting of gears failures of gearing through the fracture of pinion teeth was now practically non-existent. In modern installations of ordinary pressures and superheat the consumption of steam per shaft horse-power, as compared with that of the earlier direct-driven turbine installations, had been reduced to about half. The author then described some of the most important turbine-propelled ships which have recently been built. He referred to the high steam pressures and temperatures for marine work, and said that the estimated overall saving in fuel consumption of a high-pressure installation of, say, 500 lb. pressure, with steam superheated to a temperature of 750 deg. Fah., with a 29in. vacuum, with a feed temperature of 300 deg. Fah., and with air heaters, as compared with a normal turbine installation of a pressure of 200 lb. with steam superheated to 580 deg. Fah., was in the region of 15 per cent. The author concluded his paper with a brief reference to mechanical stoking and powdered fuel for marine purposes.

The Röttle Hydro-Electric Power Station.

No. II. (*concluded*).*

THE power-house—which is shown in Figs. 9, 10 and 11—is designed for three units, and it contains the low-tension switching arrangements, transformers, a high-tension switching station, an office and a storage room. The foundation is carried down to solid rock. The walls of the discharge pit are made mainly of lean concrete. An insulation layer of 1 : 2 cement mortar, 5 c.m. thick, was placed at El. + 90·30 and + 89·10 respectively under the switch house. Above the insulation layer the concrete surfaces of the pit are coated with asphalt. Below that level they are provided with a 15 cm. wearing layer of concrete 1 : 2 : 2½ poured against planed shutterings, except under the draught tubes, where the discharge pit is lined with clinker instead. The slab covering the discharge pit constitutes the foundation for the turbines and the bottom floor for the low-tension department of the switch house. It is made of reinforced concrete, mixture 1 : 3 : 3, and is provided with recesses and holes for the turbine machinery. The under side of the slab is coated with asphalt. In combination with the gable wall of the discharge pit two concrete brackets are arranged to serve the purpose of transmitting the thrust from the pressure pipe to the side walls of the pit. At the end of the pipe line track, between the last pipe support and the power station, there is a small detritus tank, provided with a spillway, to prevent sand and soil, which may come with the rain and leakage water along the track, from being washed down into and filling the discharge pit. From this tank a by-pass conduit carries the water past the power station to the tail race below the stop log grooves. These grooves are arranged at the downstream end of the discharge pit and are provided with a bottom sill of oak. Between the power station and the stop log grooves the slab above the discharge pit also serves the purpose of a footway. Under the distributing pipe there is a wooden planking, which is accessible from the bottom floor of the low-tension department. Longitudinal drains are arranged on both sides of the discharge pit, and the foundation under the remaining part of the power-house is also carefully drained by means of 6in. machine-made cement tubes to prevent the dampness from reaching the floor.

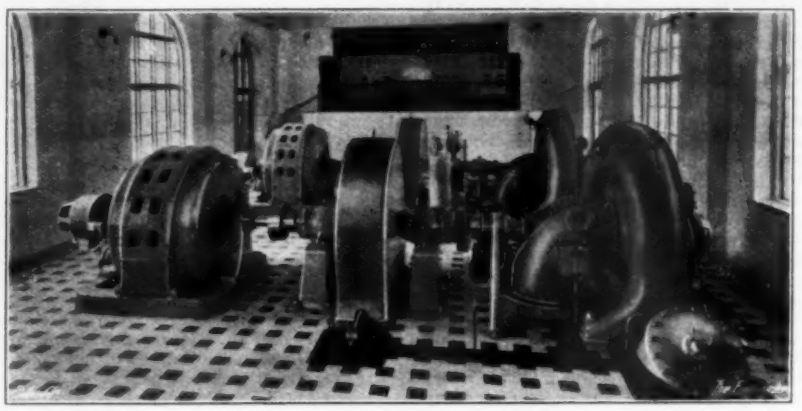

FIG. 11—INTERIOR OF POWER-HOUSE

The other foundation walls and socles under the machinery hall, repair shop and switch house, as well as the outer walls of the bottom floor of the low-tension station, are made of lean concrete. The exposed parts of the socles and the outer walls are provided with a 5 cm. surface layer of 1 : 2 : 2 concrete. Surfacings

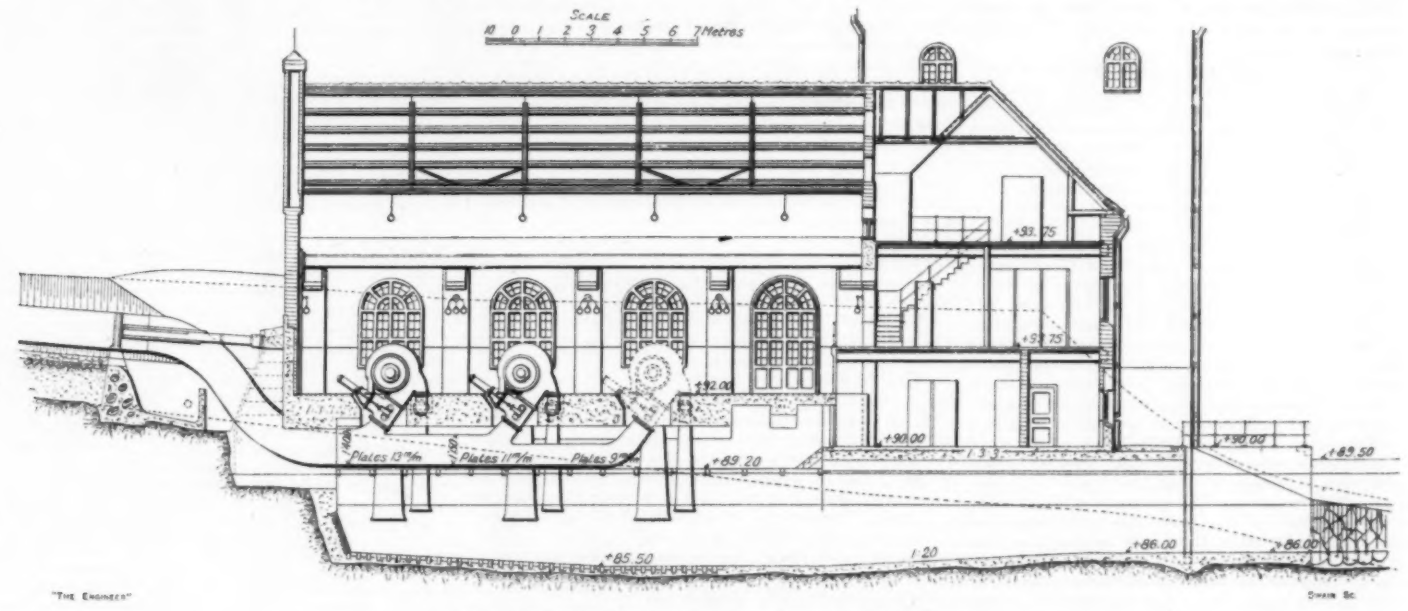

FIG. 9—LONGITUDINAL SECTION THROUGH POWER-HOUSE

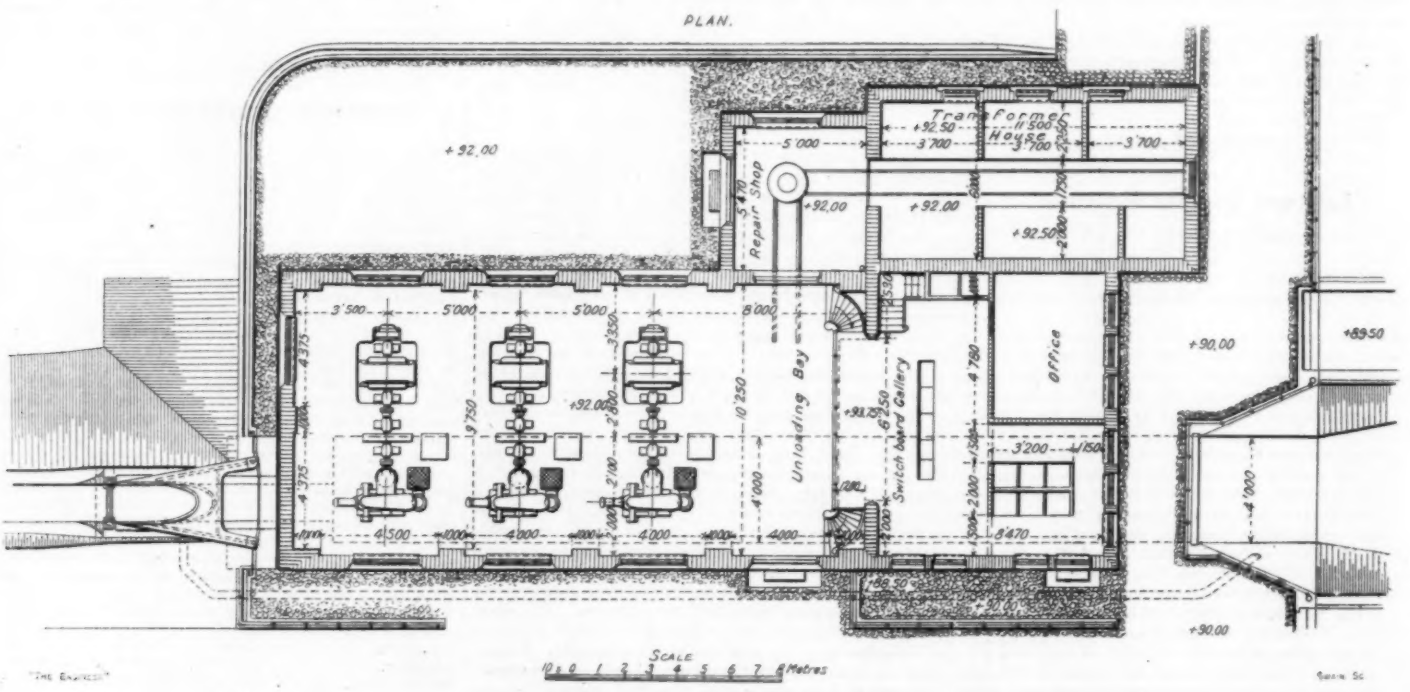

FIG. 10—PLAN OF POWER-HOUSE

coming in contact with brickwork and woodwork are insulated with asphalt.

The floors of the machinery hall and repair shop

* No. I. appeared March 9th.

the bottom floor of the switch house and the first floor of the low-tension department are made of lean concrete. The floor in the machinery hall is covered with hard-burnt clay tiles, the other floors being rendered. The cable ducts as well as the other openings in the floor are covered with checker plates supported by rolled steel angles.

Outside the power-house the discharge pit is merged into the tail-race canal, he first part of which, next to the stop log grooves, is confined between concrete retaining walls. The cross-section of these walls widens up to the quay wall, which is erected along the banks of Lake Vetter. All the retaining walls for the tail race are made of concrete 1 : 3 : 3 with 50 per cent. displacers and with a 0·1 m. surface layer without displacers. Outside the quay wall

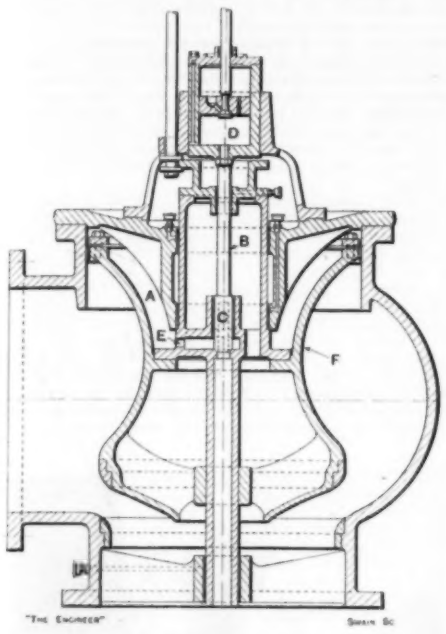

FIG. 12—RELIEF VALVE

the tail-race canal continues into the lake with sides sloping 1 : 1, and the whole section is lined with a heavy stone pitching. As protection against the waves, breakwaters are arranged along both sides of the outlet. They are made of lean concrete and are founded on stone-filled wooden cribs. The concrete faces are lined with stone. The breakwaters, as well as the tail-race canal, were completed before the erection of the power station in order to serve as unloading spaces for materials and machinery, which were transported by sea. Outside the breakwaters and the banks next to the power-house, cobble stones are placed as protection against the waves.

The plant is built complete for the full hydraulic capacity of three generating units, but only two of them have been, so far, installed. Each unit is designed to give 1320 kW at the generator shaft under a net head of 100 m., which is the head that

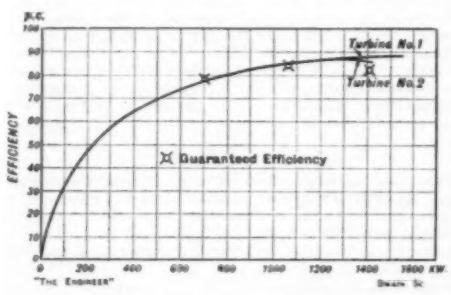

FIG. 13—EFFICIENCY CURVES

can be expected at high water in Lake Vetter. The speed is 750 r.p.m. The wheels are single runner turbines of the Francis type, with spiral casings. The casing is made of steel and the runner of bronze. Each turbine is provided with a 650 mm. hydraulically-operated sluice valve, a pressure regulator for relieving the pressure when a large proportion of the load is thrown off, and a steel fly-wheel, entirely encased and weighing about 5½ tons, together with a speed governor working with oil under a pressure of about 10 atmospheres. An interesting feature in the design of the turbine is that the operating ring of the guide vanes is suspended on the guide vane levers. The sluice valves are hand-operated with oil under pressure. The relief valve is of the type shown in Fig. 12. The pressure water is admitted to the chamber A and thereby keeps the valve closed. As soon as the load is thrown off the governor shuts off the turbine, but at the same time it opens the control valve C by means of the spindle B and the oil dashpot D. The pressure water in the chamber A escapes through the holes E, and the valve F lifts and allows the discharge to take place. The dashpot is so designed that, when the valve closes, it comes into action and allows the valve to close slowly, which gives the water in the pipe line time to retard, so that all hammer of the relief valve is eliminated. The time of closing can be adjusted. The valve opens at such a rate that the discharge is in proportion to the gate closure. When the full load is suddenly thrown off, the relief valve will limit the pressure rise in the pipe line to 10 per cent. of the normal head, and in the event of the gates opening again before the dashpot has closed the valve, the latter will close synchronously with the gate opening, so as to prevent excessive discharge of water and consequent excessive pressure drop in the pipe line. The valve does not act when the load is thrown on.

The generators are designed for 1600 kVA, 3300 volts, with cos $\varphi = 0{\cdot}8$. The transformers and accessories, which are arranged in the switch-house, are designed for the same capacity, and are rated at 3300/40,000 volts. Two 3300/10,000 volt transformers are installed for local supply.

The station was put into operation in the beginning of December, 1922, and has worked quite satisfactorily ever since. At the tests of the machinery, in February, 1923, at which the water was measured over a weir, the maximum output of the turbines was 1540 kW and 1420 kW respectively. The outputs and efficiencies of the two machines are shown in Fig. 13. The difference in the characteristics of the two turbines is due to the fact that the two runners were made of a slightly different design. The best efficiency of the generators was 95·3 and 96 per cent. respectively at cos $\varphi = 0{\cdot}8$. The results obtained are a little in excess of the guarantees given by the manufacturers.

The work was in charge of a committee, appointed by the Power Company, under the chairmanship of Mr. C. A. Reuterswärd, chief engineer of the Jönköping Electric Works. Contracts were let for the various parts of the constructional work, and the work carried out partly by A.B. Väg och Vattenbyggnader, Arboga, and partly by A.B. Järnvägsbyggnader, Motala. The pipe line and the valve in the surge tank were made and erected by Landskrona Nya Mekaniska Verkstad, Landskrona, and the turbine machinery by A. B. Finshyttan, Finshyttan, which collaborates with the British firm of James Gordon and Co., Ltd., 83, Kingsway, London, W.C. 2. The electrical plant was designed by Messrs. Bergman and Co., of Stockholm, and was supplied by the Svenska Elektromekaniska Industri Aktiebolaget, Hälsingborg. The design of the structural, mechanical and hydraulic part of the plant, the supervision of the work and the testing of the machinery was entrusted to Messrs. Vattenbyggnadsbyran, consulting engineers, Stockholm, who, as is well known, now work in co-operation with Messrs. Rendel, Palmer and Tritton, of Westminster.

A HIGHWAY bridge, which, according to the *Engineering News-Record*, is believed to hold the record for height above the valley crossed, has recently been built across the Snake River Canyon in Southern Idaho, about 3 miles North of the city of Twin Falls. The roadway is 476ft. above ordinary water level and 502ft. above the stream bed. The bridge consists of two structural steel towers, supporting a central cantilever span of 700ft. and two 225ft. anchor arms.

LOCOMOTIVE COALING PLANT AT NINE ELMS

MITCHELL CONVEYOR AND TRANSPORTER COMPANY, LTD., LONDON, ENGINEERS

Locomotive Coaling Plants.

IN starting this brief account of a few days spent in examining several plants installed for the purpose of filling the tenders of locomotives with coal, we feel that really only half the story can be told, for much more remains to be done in the way of organising our locomotive depôts on labour-saving lines. Here we are merely concerned with the provision of coal supplies, but an engine also requires water, sand and other stores, and it would seem that a development of the idea of mechanical coaling might well include a progressive system of supplying the locomotive until it was ready for the road again without there being any necessity for shunting back and forth, with a corresponding loss of time. The extent of time lost by engines in waiting their turn for supplies of coal and so forth under the usual *régime*, is not fully appreciated, and may amount to such a length that an extra shift of engine men has to be employed to manœuvre the engines up to the coaling stages. The added expense of such a system, to say nothing of the lost earning time of the locomotives, needs no emphasis. If, as is the case with at least one of the coaling equipments reviewed below, a saving of some £16,000 a year can be effected, on a capital cost of about the same amount, it is fairly evident that were the idea extended to cover the other requirements of "setting away" an engine, there would be a vast saving in railway running expenses.

The coaling equipments which we illustrate on page 294 and in the accompanying engravings have been supplied by the Mitchell Conveyor and Transporter Company, Ltd., of 45, Holborn-viaduct, E.C. 1, to several railway companies in this country, and we have to thank the chief engineers of those companies for the facilities which they offered to us for the examination of the plants in working conditions.

It may be as well first to explain that the broad principle of the Mitchell plants is to elevate a complete truck of coal, to tip the coal into an overhead bunker, and then to draw it off, from below, as required by the locomotives. Included in our illustrations there are, however, one or two special plants embodying somewhat different principles that have been so designed on account of the special requirements of local conditions.

Taking the plants seriatim as we visited them, they are that at Nine Elms, see above; at Feltham, Fig. 1; at Willesden, Fig. 5, page 294; at Ramsgate, Fig. 6, page 294; at Doncaster, Fig. 3; at Whitemoor, near March, Fig. 4; and at King's Cross, Fig. 2.

THE NINE ELMS PLANT.

Of these installations, that of the Southern Railway at Nine Elms is the earliest example, and is shown above complete, except that the corrugated sheeting over the steel framework had not been fixed. Generally speaking, such covering in is not necessary, as will be gathered from our other illustrations, but it was thought desirable at Nine Elms to minimise any dust nuisance. This plant is also noteworthy on account of the fact that it had to be constructed astride an existing coaling siding without disturbing work on the siding, which is approached through the wide portal seen under the main bunker. The metals on which the locomotives run up to receive their coal are on either side of the bunker, while the incoming coal siding is on the left.

The coal trucks are run, one at a time, on to a cradle lying in a pit at the bottom of the inclined elevator. They are roughly positioned in the centre of the cradle and the brakes are pinned down. No other fastening is necessary, but good security is obtained in the following manner:—When the cradle is resting in the pit it naturally lies horizontally, so that the trucks may be run on to it off the

siding; but as soon as the winding up is started, it is tilted over towards the elevator. The truck then cants over and is caught by a wooden buffer beam. In this position a large part of the weight is carried by the buffer beam and there is no chance of the truck moving as it is hoisted up. The blow on the beam as the truck tips is quite gentle, and it seemed to us that this was the case whatever type or size of truck was being handled—these plants are intended to take any size of truck up to 20 tons capacity.

The tipping action is obtained in the following manner:—The cradle has an approximately L-shaped frame, with the vertical leg lying on the elevator guides, and the horizontal leg underneath the track. Between the horizontal legs there is pivoted a secondary frame for carrying the railway metals and the pivot is arranged outside the centre of the track. When the cradle is in the bottom position the secondary frame rests on stops built up from the ground, so that the metals must register with those of the siding. When, however, hoisting is started the frame leaves these stops and being out of balance the truck must tip over against the buffer beam.

At Nine Elms the hoisting is effected by a double purchase, with a rope at either end of the cradle. The ropes are anchored at the top of the hoist, pass down behind and underneath the cradle, over guide shears, and then up on the outside to the winch, which is arranged in the house at the extreme top of the structure. In this way an even lift is given to the two sides of the cradle, so that there is little stress on the guides, and there is room between the two falls of the rope for the passage of the truck.

On each of the vertical legs of the cradle there are two guide wheels, one above the other, which run on separate guide rails. At the top of the hoist the guide for the lower wheel is bent outward, so that the cradle is tilted toward the hoist and the top wheels run into cup-shaped recesses, which make them act as pivots about which the cradle turns. As the winding proceeds, the angle of tilt increases until the coal in the truck begins to fall out into the adjacent hopper. At this moment the top of the truck is met by a "sustaining beam"—that is to say, a longitudinal beam—which follows the truck through the tipping action and prevents it falling into the hopper. This beam is supported on radius arms from the centre of rotation,

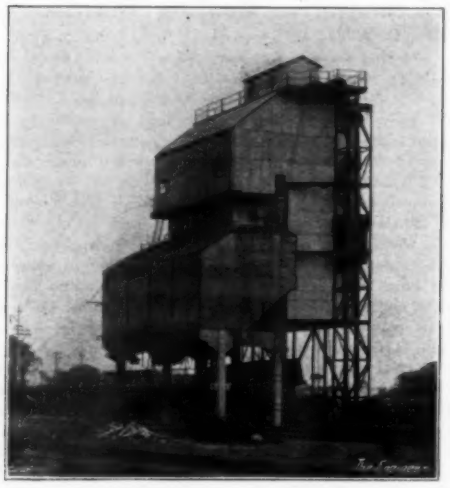

FIG. 1—COALING PLANT AT FELTHAM

and is held in check by wire ropes and balance weights sufficiently heavy for the largest truck. Thus it will be seen, throughout hoisting and tipping, the truck is gripped entirely automatically, and in a very simple manner. To return the truck, after it has been turned upside down, the hoist is simply reversed, and the sustaining beam pulls the truck back until it is in a position to run down by gravity.

In order to reduce the load on the motor in hoisting, part of the weight of the cradle and truck is counterbalanced by weights running down an inclined track. At the bottom the tracks curve outward to a more or less horizontal direction, so that the balancing effect of the weights is reduced as the truck is tipped. The counterweight ropes are wound on the same drums as the hoisting ropes; but, of course, in the opposite direction, and with the help of a purchase the length of travel of the weights is made to correspond with that of the cradle. The winch needs little comment, as it is a simple machine driven through machine-cut gears by a 30 horse-power motor. The control cabin is on the ground level, but there is a limit switch, geared with the winch drum, to cut off the current to the motor at both ends of the operation.

The hopper is a reinforced concrete structure capable of holding 400 tons of coal and is divided into two compartments. At the inlet there is a depending flap valve, which can be moved to one side or the other, so that the incoming coal can be diverted to either side and so that two qualities may be stored separately. There are eight discharge shoots, all told, so that with the two coaling sidings there are two shoots for each quality of coal on each siding. These discharge shoots, like all the others of this type which we saw, have double doors. The intervening space has a capacity of 10 cwt. of coal, the idea being that the attendant can supply locomotives with 10-cwt. lots at a time and keep a check on the consumption of coal. It was very noteworthy, however, during our tour that the men paid little attention to this refinement, and relied upon their judgment as to the amount of coal given to any one engine. For the sake of expedition they just let the coal run through the shoot and estimated the quantity delivered. A subsequent investigation of accounts showed that these men have a remarkable aptitude in judging the quantity of coal put into an engine's tender.

In the case of this plant at Nine Elms the bunker can be filled in a little over two hours, and during that time requires the attendance of four men, two on the ground level and two at the hopper inlet; but the last two could be dispensed with were it not for the fact that much "run of the mine" coal is handled and the large lumps have to be broken up on a grid before they can be allowed to enter the hopper. This amount of labour compares with twenty-eight men who were required for hand coaling, while the engines do not now have to wait for hours for their turn to get coal. From 100 to 125 locomotives are supplied with coal daily.

THE FELTHAM PLANT.

The next coaling plant which we visited also belongs to the Southern Railway, and is that at Feltham. It is shown in Fig. 1. This plant is noteworthy on account of the fact that it was designed concurrently with the yard it serves, so that its arrangement was not restricted by previously existing conditions. The broad principle of the design is the same as that at Nine Elms, but a vertical hoist has been adopted, as the sidings could be brought close alongside one another. The hopper in this case is of 200 tons capacity, divided into two compartments, and has a flap valve for the distribution of the coal. As only small coal is handled by this plant it is unnecessary to have any men up aloft to break up the large lumps. Two men are required for about one hour, which is the time taken to fill the bunker, and then one of them can go on to other duties, while his mate remains to coal the locomotives as they arrive.

THE WILLESDEN PLANT.

Following the routine of our journey, the next plant to be considered is that of the London, Midland and Scottish Railway at Willesden, which, as will be seen from Fig. 5, page 294, is totally dissimilar to those just described. In this case the provision of a large overhead storage bunker was not feasible, so the coal wagons are tipped at ground level and the coal is fed to the locomotives much as it is tipped. On reference to Fig. 5 it will be seen that there is a rotary tippler at the back of the plant. This tippler is capable of taking trucks of up to 12 tons capacity and shoots their contents into an underground hopper. The coal is prevented from falling out of the bottom of this hopper by a circular plate mounted on a vertical axis so that it can be rotated. Just above this plate there is a lateral opening in the side of the hopper, but the coal does not run out through it on account of its natural angle of repose. When, however, the plate is rotated the coal is drawn forward and a plough scrapes it off through this opening into a skip in a pit alongside. This skip has a capacity of about 15 cwt., and when it is full is hoisted up the gantry and tipped into an overhead bunker of 5 tons capacity. In order to prevent the skip being overfilled so that coal would be spilled in the bottom of the pit, there is an automatic arrangement to stop the rotary table when the skip is full. This device takes the form of a counterbalanced lever at the top of the gantry, over which the hoisting rope is led by means of pulleys. When the skip is filled the balance is overcome, the lever rocks on its pivot and a switch stops the motor operating the table. As soon as the skip is full a man in an upstairs cabin, just below the level of the hopper, starts the hoisting winch and the rest of the operation is performed automatically. This plant requires the attendance of two men, one at the tippler and the other in the cabin, and during an average day handles 240 tons in the winter to over 300 tons in the summer, while as much as 205 tons have been passed through it in one eight-hour shift. It is possible to tip a coal wagon and return it to the normal position in about three-quarters of a minute, but we noticed that the men prefer to tip the trucks gently and by degrees, so that they may have an opportunity of catching anything that might fall out of the truck and obstruct the mechanism. In any case it would seem that the capacity of the plant is mostly limited by the rate at which coal trucks can be placed on the tippler, while, in view of the fact that the average requirements of locomotives at Willesden amount to only 2½ tons or so, there is no fear of an engine having to stand by while the overhead hopper is being refilled.

THE RAMSGATE PLANT.

We now revert to the Southern Railway, whose plant at Ramsgate is illustrated by Fig. 6. At first sight it bears a close resemblance to that at Feltham—see Fig. 1—but there are several distinctive features—the structure is almost entirely of reinforced concrete, the hoist is on a single purchase, and duplicate motors are provided for the winch.

The adoption of the single-purchase hoist has entailed a change from the Nine Elms and Feltham designs for the following reason. It is obviously desirable to attach the hoisting ropes to the cradle about its centre of gravity so as to relieve the guide wheels as much as possible, but if the ropes were so attached directly they would be in the way of the trucks going on to and off the cradle. So the attachment is made through the intervention of a heavy lever, which can be seen, with the cradle in the raised position, in Fig. 6. This lever is pivoted to the cradle at about its centre of gravity and at its long end has a shackle for the hoisting rope; there are, of course, two ropes, one for either end of the cradle. The long end of the lever is of such a dimension that when it lies horizontally its span is greater than half the width of the coal truck, so that the hoisting rope is held back behind the railway loading gauge, an event which, naturally, only happens when the cradle is resting on the ground and the ropes are slack. In order to ensure that the lever does take up this position its short end is provided with a roller, which comes into contact with a fixed slide on the ground as the cradle settles on to its seating. The result of this arrangement is that when hoisting is started the lever is gradually brought into a more or less vertical position in line with the lead of the rope, and as the roller on its short end moves on the fixed track it gently starts the cradle into motion, during which process the truck tips over against the bolster, as already described. Then the hoisting continues just as if the rope were attached directly at the centre of the cradle.

The leads of the hoisting and balance-weights in this case are peculiar in that both ropes are accommodated on one drum on the winch. Hence as the hoisting rope is wound in the balance rope is paid out, and the two ropes are accommodated in one set of grooves. The arrangement has the advantage that the drum is compact, but it entails the provision of guide sheaves to bring the balance rope over the well down which the weights slide. The balance-weights are made in three separate sections, in such a manner that when they come to rest on the ground the weight of one section after another is taken off the rope and the counterbalancing is accommodated to the reducing load of the tipped wagon. A peculiarity of this hoisting gear is the provision of two driving motors, either of which is capable of running the plant. The two motors are connected with the hoisting drums by means of clutches, so that they may be put into service alternately. They are capable of hoisting, tipping and returning a 20-ton wagon in four minutes, and it is possible to fill the 200-ton bunker in less than an hour.

THE DONCASTER PLANT.

Our next visit was to the Doncaster depôt of the London and North-Eastern Railway, where we discovered one of the most hardly worked plants of the lot. It normally has to deal with 150 engines a day, and coals over 1000 engines every week, while 191 engines is considered as a good day's work. This plant, which is illustrated in Fig. 3, page 294, is also noteworthy in that it includes gear for the provision of sand to the sanding boxes of the engines.

The hopper, as will be seen from the engraving, straddles two lines of siding, and is capable of holding 500 tons of coal with 30 tons of sand. The system of hoisting and tipping the coal wagons is similar to that of the single-rope arrangement already described, but the balance-weight ropes are accommodated on separate drums, as can be seen in Fig. 3, so that they have a direct lead. It is also noteworthy that the whole of the structure is of reinforced concrete.

We were fortunate at Doncaster to secure at first hand some statistics as to the running of the plant, and as it has been in service for about two years, these figures may be taken as being indicative of the savings which can be effected. We were told, for instance, that by working continuously the plant would be able to handle 10,000 tons of coal a week; but that ordinarily it is only necessary to hoist for five or six hours a day, and there is then sufficient coal to supply 150 engines every twenty-four hours. The average traffic is 1070 locomotives per week, and a good day's work is 190 engines. Before the new plant was installed, it required twenty-eight men at the staging to coal the locomotives by hand, but now four men are sufficient, and three men could do the work if all the coal

FIG. 2—COAL HOIST AT KING'S CROSS

wagons were fitted with oil-lubricated axle-boxes, and, consequently, could be easily handled on the siding. The present cost is 1·505d. per ton, as compared with 8·75d., and the electricity consumption is about 1 unit per 10 tons of coal hoisted. The records also show that the new system has effected a saving of 59,072 engine hours per annum, which, taking into account the saving in wages, effects an economy of £16,000 a year.

THE WHITEMOOR PLANT.

The plant at Whitemoor sidings, March, Cambridgeshire—see Fig. 4—is very similar to that at Doncaster, except that the bunker is smaller, having a capacity of 350 tons, and there is no sanding gear; but we include the illustration as it shows so plainly a coal wagon half-way up the hoist. A little incident which we noticed there is indicative of the smooth running of these plants. It was a pair of pigeons nesting in one of the balance-weights, and we were told that they had hatched several broods there.

THE KING'S CROSS PLANT.

The plant at King's Cross—see Fig. 2—is quite a small affair, and is only intended to add a ton or so of coal to an engine's bunker, so that it may leave the terminus quite full for a long journey. It is principally used for supplementing the coal supply to suburban tank engines. There is a narrow, 2ft., gauge track alongside the coal siding on which small "tubs" of 10 cwt. capacity are filled from the wagons by hand. This operation is simplified by the fact that the trucks are so placed that the wagon doors can be dropped on to the edge of the tubs. In order to prevent spillage between two tubs, the edges of one are made to overlap the next when shunted close together. In this way a train of tubs, looked at from above, has the appearance of a long continuous bin, divided into compartments where two tubs adjoin. The broad-gauge siding on which wagons are unloaded into the tubs holds sixteen wagons, *i.e.*, one week's supply, say, 190 tons. Twelve small tubs are provided, enabling 6 tons of coal to be kept in readiness. The hoist will put up 1 ton, *i.e.*, two tubs, of coal in about three minutes. Tank engines generally take about ½ ton or 1 ton; tender engines, 1 or 2 tons, occasionally more. The average rate of working is about 10 tons per hour.

Railway Matters.

IN the House of Lords on March 8th the resolution of the House of Commons of the 6th, to take the Road Transport Bills by a joint committee of the two Houses, was agreed to.

IT is now officially announced that the London, Midland and Scottish, the London and North-Eastern and the Great Western railways are making experiments with a view to providing lying-down accommodation for four passengers in third-class compartments on long-distance trains.

THE Southern Heights Light Railway is a projected line, 15 miles in length, from Sanderstead, through Chelsham and Cudham, to Orpington, with a junction at each end with the Southern Railway. It is proposed that that company shall equip the line for electric traction at a cost of £140,000 and work it.

THE directors of the London, Midland and Scottish Railway have appointed Mr. J. Purves, chief outdoor assistant to the carriage and wagon superintendent at Derby, to be divisional carriage and wagon superintendent at Wolverton, in place of Mr. C. L. Mason, whose resignation was mentioned on page 226 of THE ENGINEER of February 24th. Mr. E. G. Oliver, chief assistant at Wolverton, succeeds Mr. Purves.

IT is officially announced that Mr. W. Y. Sandeman, who began his railway engineering career on the North British Railway, but left there in 1915 to take charge of the constructional work at Victoria Dock, Port of London Authority, and subsequently served during the war in the Royal Engineers, and then returned to the North British headquarters in Edinburgh, has been appointed the engineer for the Northern Division of the Southern Scottish area of the London and North-Eastern Railway with his office at Thornton.

IN former days railway engineers were as a rule very reluctant to have their praises sung. It is the same to-day, but now that the companies have publicity departments, no opportunity appears to be neglected to record events that have, through all these years, been regarded as part and parcel of an engineer's ordinary duty. The public now reads, for instance, of a big bridge being replaced in a few hours with little or no delay to traffic. But fifty years ago the same work was done, by the same means and in the same time. Then, as now, the new bridge was built on a platform by the side of the one to be renewed, and, when completed, a platform was built on the other side of the bridge. As soon as the morning trains had passed, the old bridge was drawn on to the vacant platform and then the new bridge hauled off its platform into position, and the roads again joined up ready for the evening trains. Quite recently public attention was directed to two pieces of engineering work which, whilst important undertakings, were by no means exceptional. One was the relaying of some lines on the arrival side at King's Cross and the other the slewing of a signal-box bodily at the west end of Wimbledon Station. Both works did credit to the engineers responsible, and it is only right that praise should be given them. But it must not be imagined that their predecessors had no similar work or that it was not as well done and as deserving of praise.

THE first stage of the further electrification scheme of the Southern Railway, decided upon in August, 1926, to be brought into use will be the former Brighton Company's line from London Bridge, through Forest Hill, to South Croydon, and on, over the former Brighton and South-Eastern and Chatham Joint line, to Purley, and thence, in the one direction, to Caterham and, in the other, to Tattenham Corner. The new service will be brought into use on March 25th; but, as related in this column on March 9th, the business trains will start and terminate at the low-level station at London Bridge. The section on the old Brighton line now being brought into use has hitherto only carried steam-worked trains; it is not one of the lengths where the overhead construction is being replaced by third-rail operation. Hitherto, also, there have been no regular trains to Tattenham Corner, but only to Tadworth. Now the former station will be used all the year round and not alone for race meetings. The next step is the conversion of the operation by overhead construction to the third rail method between Victoria and London Bridge and from London Bridge through West Croydon to Sutton. That will, it is hoped, be done in June, where also the electrical working will be put on to Banstead branch between Sutton and Epsom Downs. The first stage covers 86 track miles and the second stage 79 miles. The third and last stage of the programme will be completed early next year.

IN the spell of dense fog experienced in London during the first week of last October there were two collisions near Old Oak Common on the Great Western Railway. Both were inquired into by Colonel Sir John Pringle, whose reports thereon have recently been issued. The first occurred just after midnight of October 4th–5th. There were few personal or material injuries. A rail motor train was pulled up at Ladbroke-grove down main line home signal, because the signalman there had not had the train accepted, in view of the passenger train still being in the section. Having brought the rail motor train to a stand, the signalman lowered the signal for it to draw forward to the starting signal. The driver failed to see that signal, and passed it in ignorance of its condition at "danger," and his train collided with a passenger train which was standing at Old Oak Common East outer home signal. Sir John Pringle blames the signalman at Ladbroke-grove for not verbally warning the driver, and censures the latter for not proceeding with greater caution when he found he had missed the signal. The second collision was on the morning of the 7th, when the signalman in Old Oak Common East box failed to signal forward a train of empty carriages, which consequently stood, forgotten, in the fog at his starting signal, and into which a rail motor train came into collision. There were no personal injuries to passengers, but the guard of the standing train was badly hurt. A length of track circuit at the starting signal to protect standing trains is recommended by Sir John

Notes and Memoranda.

IT is said that the agricultural produce which accumulates at Paichun, the terminus of a new branch from the Chinese Eastern Railway, amounts to 500,000 tons a year.

ACCORDING to Mr. H. A. Curtis, the chief engineer and general manager of the Hydro-Electric Department of Tasmania, the State possesses available water power to the extent of 1,750,000 horse-power.

A PROCESS has been evolved in Germany for the dyeing of timber as it grows. Some holes are bored in the base of the tree trunk and in its roots. These holes are supplied with liquid dye from an overhead tank, and it is said that the whole of the wood is consequently coloured. From 75 to 100 gallons of dye are required for an average tree, so the process is rather expensive.

IT is claimed that the Diesel generating plant in the Lokawei station of the French Tramway Company in Shanghai, is one of the largest of its kind. It comprises a 5250 horse-power, eight-cylinder, two-stroke motor, driving an Oerlikon alternator that gives the entire plant a total capacity of 12,000 kilowatts, with a prospective addition of a sixth set of Diesel engines to raise it to 16,000 kilowatts.

RECENT work on sand-lime brick at the American Bureau of Standards has consisted in testing this product for stress-strain relationships. Twelve bricks were tested. Four were tested in tension, four in compression on end, and four in compression edgewise. With the bricks tested on edge the secant modulus of elasticity varied from an average value of about 1,700,000 lb./in.^{2} at no load to about 1,600,000 at a stress of 1000 lb./in.^{2}. For a second loading the modulus of elasticity was nearly constant throughout the loading and its average value was about 1,600,000 lb./in.^{2}. The modulus of elasticity in compression was about equal to the modulus in tension.

A NEW cotton fabric for use in highway construction is reported to have been produced by the New Uses Section of the New Orleans Cotton Textile Institute. The new fabric was developed by the Bureau of Standards in Washington in co-operation with the Institute's textile engineers. The fabric is stated to be a loose cotton mesh. It is laid over a cement base and on top of the fabric the surface of the roadway is moulded. The layer of fabric provides a cleavage plane between the surface of the road and the foundation, so that in case of repair the top layer of the roadway can be removed and a new surface laid down without impairing the permanent foundations. It is expected that at least 1,000,000 yards of the fabric will be used this year, and that in three years over 5,000,000 yards will be used annually.

IN the course of a study of the formation of peat being conducted by the United States Bureau of Mines, Department of Commerce, samples of peat have been collected at various depths in Wisconsin peat bogs and are being analysed to determine the rate of decay of various vegetable constituents, such as woody matter and cellulose. The main question to be decided is whether wood (lignin) or cellulose, the principal constituents of plants, decays completely in the process of peat formation. If either decays completely, leaving no solid decomposition products, it can be concluded that the other is the original substance from which coal was formed. It is generally conceded that coal was formed from peat. Since the action of bacteria plays an important part in the decay of vegetable matter, a thorough investigation of this phase is now being made. It has been found that bacteria exist at all depths in the peat bogs, but they are probably more or less dormant in the lower levels. It has been found, further, that where bacteria have become dormant, their activity is quickly resumed when supplied with available nitrogen.

ACCORDING to Mr. G. A. Alder, of Middlesbrough, the commonest causes for complaint against steel wire are failure to fulfil the tensile, torsion and bend tests. The microscope helps tremendously to settle the cause of failure. Finely divided inclusions of alumina and slag are responsible for bad torsion tests on account of the specks of material breaking up the long fibres, and in some cases deflecting the flow of the metal and causing a wavy structure. Very fine inclusions seem to cause far more trouble than the more substantial variety. It is, he says, in a paper read before the Cleveland Institution of Engineers, seldom that one comes across a failure due to overdrawing of the material in the ordinary sense, but it is possible to have a material so badly treated in patenting that the usual amount of drawing cannot be given without breakdown. Too low a temperature or too slow cooling gives rise respectively to too small a grain, which will not elongate sufficiently, or to the presence of pearlite, which, although softer than sorbite, is not so ductile. The pearlite, moreover, frequently lies with its laminations across the direction of flow, and either diverts the flow or breaks up the fibres.

IN 1924, at an experimental plant in New Jersey, where the manufacture of pure lead tetra ethyl was being carried out, a number of serious poison cases occurred, says *Nature*, and the newspaper publicity which followed led to a voluntary suspension of the sale of ethyl petrol in the United States until the poison hazard had been investigated by the Surgeon-General of the United States Public Health Service. It was recognised that the manufacture and handling of lead tetra ethyl is attended with danger if not done with proper precautions, but the debatable points were the hazards to retail distributors, garage employees, and the individual users of ethyl petrol in which the lead compound is diluted by about one part in 1300. After elaborate and careful investigations, it was concluded by the Surgeon-General that no poison hazard could be traced to the use of ethyl petrol, and the manufacture of lead tetra ethyl was resumed on June 1st, 1926. Researches in the direction of finding other substances of a non-poisonous character and equally as efficacious as lead tetra ethyl, have up to the present been without success, although iron carbonyl is used to some extent in Germany, so that unless a grave and well-established hazard exists, the abandonment of the use of lead tetra ethyl does not appear to be justified.

Miscellanea.

SOME £55,000 is to be expended on the water supply scheme for Witbank, South Africa.

A GRAIN elevator of 2,000,000 bushels capacity is to be erected at Collingwood, Ontario, at a cost of about 900,000 dollars.

IT is probable that two more 10,000-kW generating sets will be added shortly to the power plant of the Johannesburg Corporation.

FOR the first time in its history of seventy years, the Mill Close lead mine, near Matlock, is stopping production, owing to the low price of lead in the market.

AT a recent meeting of the board of directors of the South Manchuria Railway Company, it was decided to appropriate 1,500,000 dollars (about £150,000) for the erection of a large observatory at Tahoshangshan, Kinchow, in the leased territory of Kwantung.

IT is announced that a contract to build 150 miles of railway for the Turkish Government, involving a total expenditure of nearly sixty million dollars, has been secured by America. The contract includes the construction of breakwaters, piers and modern docking and loading facilities at the ports of Mersina on the Mediterranean and Samsun on the Black Sea.

THE eastern galleries of the Science Museum at South Kensington have now been filled with exhibits illustrating the progress of marine construction. The King will, according to an announcement in *The Times*, open the new buildings, of which these galleries are part, on March 20th, and it will then be possible, for the first time, to study without difficulty what is said to be the finest collection of this kind in the world.

A MESSAGE received from Buenos Aires states that the Federal Government has given the Riachuelo—or Matanzas river—shops of the Ministerio de Obras Públicas an order for a floating dry dock for the port of Buenos Aires. Conditions are favourable for such a dock, the site being well sheltered, with sufficient depth of water. The dock, which will be 115 m. long and similar to that already constructed in Holland for the Argentine Government, will take vessels up to 7800 tons. The whole of the machinery will be electrically driven. It is expected that the dock will be put into service within two years.

AT a recent meeting of the Junior Institution of Engineers, Mr. E. S. Huntingford said that there were more air compressors of 200-300 cubic feet capacity than any other, and nearly all of them were single-stage machines in which the free air was drawn into one or more cylinders and compressed to the final pressure, and were generally of the vertical single-acting type. The proper method of rating compressors was by reference to free air capacity, because the actual output depended much on clearance spaces, valves and port areas and temperatures, and not solely on piston displacement. A well-designed compressor would give an efficiency of 75 to 80 per cent.

AN aerial ropeway is, according to *Columbia*, now under construction from Cucuta to the Port of Gamarra on the Magdalena River. The distance is 105 miles, or 29 miles from Gamarra to Ocaña and 76 miles from the latter town to Cucuta. The capacity of the cable will be 20 tons per hour in both directions, and the speed will be 18 miles an hour. About 32 miles have been completed. Another aerial ropeway to be constructed will connect Manizales with El Choco, a distance of 115 miles. The aerial ropeway from Manizales to Mariquita, on the Dorada Railway, a distance of 45 miles, has been in operation since 1922, and is the property of the Dorada Railway (Ropeway Extension) Company, Ltd., an English company.

A GOVERNMENT Commission has been appointed to study conditions at the port of Rosario, Argentina, the docks and railways of which are operated by a French company. At present the port is accessible to ocean-steamers of medium draught only, and it is proposed to increase the depth of the river so as to provide a safe approach for larger and deeper-draught vessels. The equipment of electric and steam cranes will be augmented, and an additional floating crane acquired. At present there are 2·7 miles of crane-track along the wharves. Two of three of the dock warehouses may be enlarged, and the installation of a second grain-elevator, with a capacity of 40,000 cubic metres and capable of loading grain at the rate of 800 tons to 900 tons an hour, is contemplated.

WE learn from the monthly returns of the National Federation of Iron and Steel Manufacturers that the number of furnaces in blast at the end of February was 148, the same as at the end of January; during the month six furnaces began and six ceased operations. Production of pig iron in February amounted to 550,800 tons, compared with 560,500 tons in January and 571,100 tons in February, 1927; there was thus a slight rise in the daily rate of production as compared with January. The February production includes 190,000 tons of hematite, 187,300 tons of basic, 130,000 tons of foundry and 23,300 tons of forge pig iron. Production of steel ingots and castings in February amounted to 764,400 tons, compared with 626,200 tons in January and 826,800 tons in February, 1927.

ALTHOUGH a period of twelve years was allowed, under the contract, for the construction of the Port of Antofagasta, the work, begun in the summer of 1919, has advanced so rapidly that the prospects of completion well in advance of the date are good. The work will cost, however, about £3,000,000 instead of £1,700,000, the amount of the earlier estimates. The principal construction, a breakwater 1470 m. long, will have an arm extending to the north-east for 650 m., continued by another 820 m., long, turning in a direction due north, and affording a depth of 28 m. The port, formerly an open roadstead in the middle of Moreno Bay, will be converted into a safe harbour 36 hectares in area and ranking second in importance on the West Coast of South America. Within the protected water four ocean liners and four coasters will be able to discharge their cargoes simultaneously. The new wharves and docks, which will afford ample accommodation for the largely increased trade anticipated at the port, are practically finished.

LOCOMOTIVE COALING PLANTS

MITCHELL CONVEYOR AND TRANSPORTER COMPANY, LTD., LONDON, ENGINEERS

(*For description see page* 291)

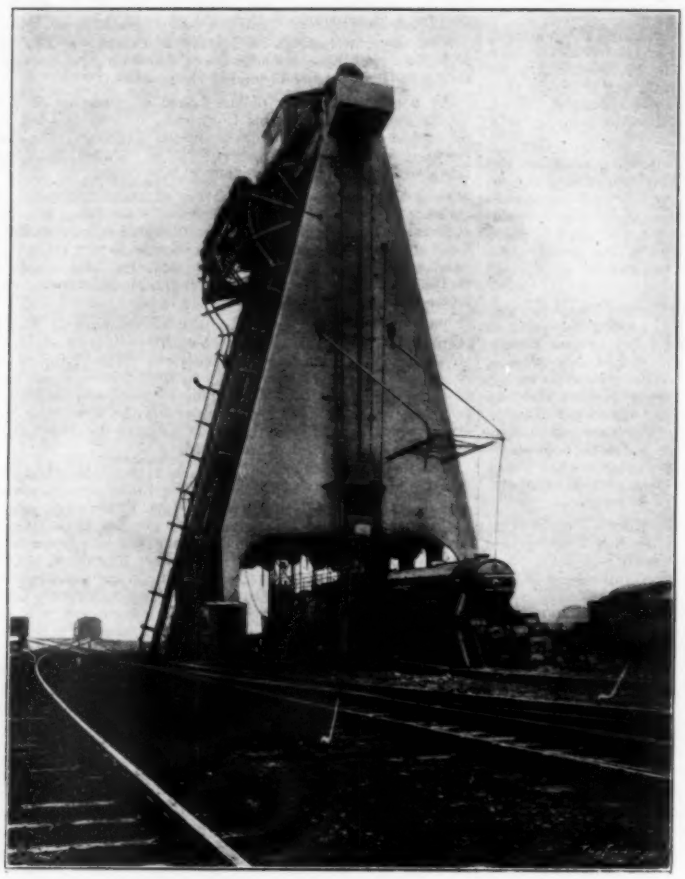

FIG. 3—COALING PLANT AT DONCASTER

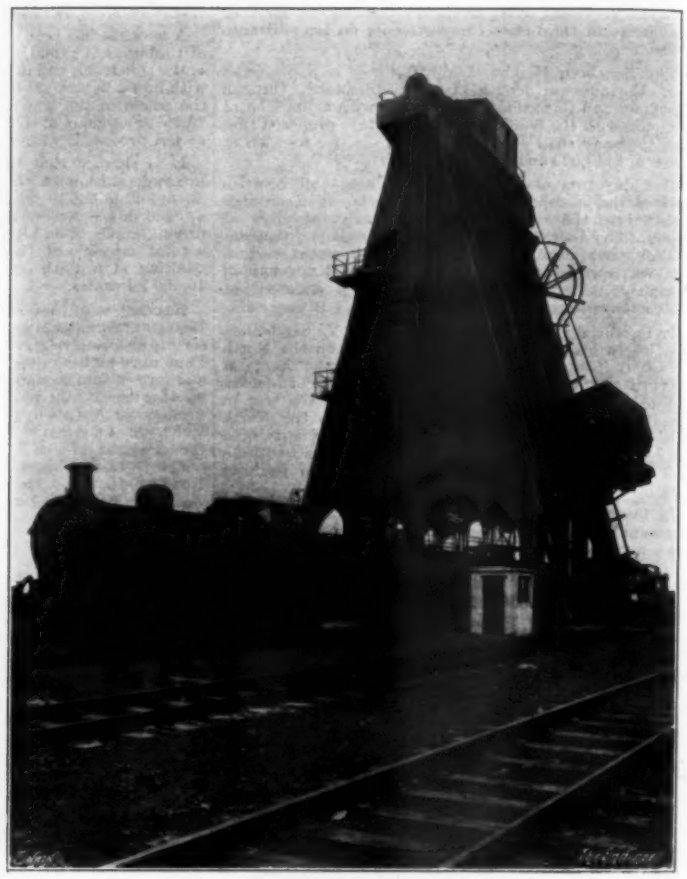

FIG. 4—COALING PLANT AT WHITEMOOR

FIG. 5—COALING PLANT AT WILLESDEN

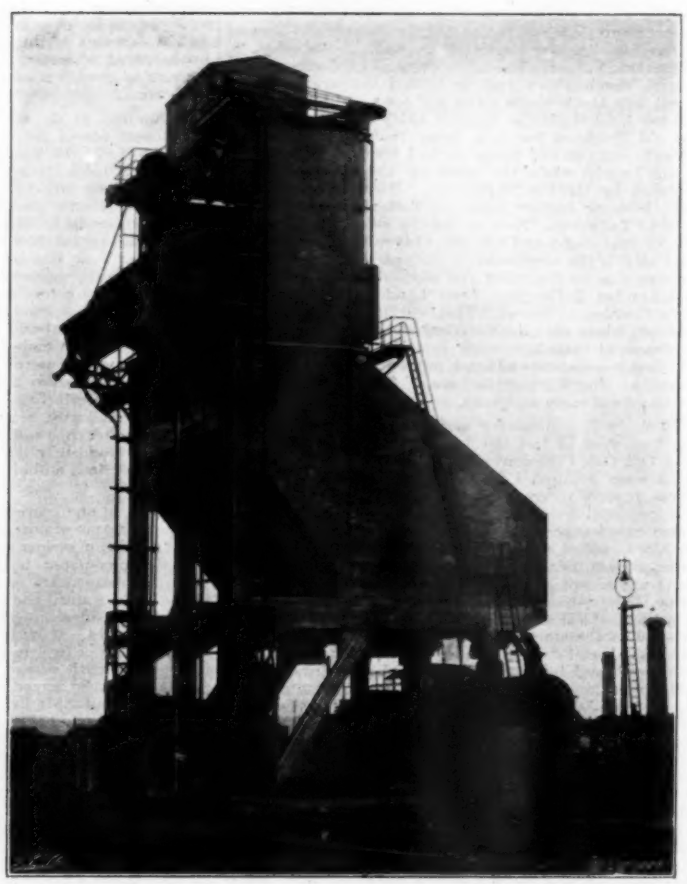

FIG. 6—COALING PLANT AT RAMSGATE

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NOTICES TO READERS.

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THE ENGINEER.

MARCH 16, 1928.

The Question of Trade Fairs.

No person conversant with the great annual Fairs on the Continent, of which the Fair at Leipzig may be taken as the highest development, can doubt for a moment their influence on trade. The oldest of them were founded centuries ago, when difficulties of communication and absence of other facilities for business made it necessary to have central markets where goods could be displayed and where traders could meet in personal intercourse. Under modern conditions, therefore, their existence might seem somewhat of an anachronism. But railways, telegraphs, postal services, and other aids to commerce appear to have assisted rather than rendered superfluous the great industrial exhibitions into which the Fairs have developed. The idea of a central market place where buyers can see the goods they desire is as old as civilisation, and the extension of that idea to cover a show and sales ground of national, rather than merely local importance, is a natural outcome of the trend of modern industry. Far from diminishing, the continental Fairs seem to be increasing in popularity, largely, no doubt, on account of the changed economic conditions and increased national self-consciousness since the war.

A consideration of trade Fairs as they exist to-day gives rise to various reflections. They differ from the great exhibitions organised in various countries from time to time, in that they are essentially annual shows, lasting but a few days only. Their recurrence at the same time and place every year engenders amongst buyers not only a habit of attending them, but a custom of deferring the placing of orders till they see what the Fair has to offer. On a small scale the machinery section of the Smithfield Club Show is an excellent example. The goodwill thus created gives manufacturers an inducement to be adequately represented, and the expense, although annual, is mitigated by the brevity of the Fair. Furthermore, when a Fair attains an importance in any way comparable, for example, with that at Leipzig, where something like 10,000 exhibitors assemble every spring to display their goods to 150,000 visitors, registered as potential buyers, it becomes possible for manufacturers to disregard all the minor exhibitions of the country. They thus limit their exhibiting expenses to the one annual show, attended by people bent on business rather than on sight-seeing. While "the education of the public" is always laudable and may at times be profitable in the case of certain articles, it is very questionable whether the results obtained warrant the expense when anything of a technical nature is concerned. The principle of excluding the sight-seeing public is typical of the business Fairs, and their success would seem to justify it. That they are successful is proved by their growth, and that their increasing success is regarded almost as a national concern is shown by the granting of free visas and special rates on the Government railways to visitors, not to mention the elaborate organisation for providing information and finding lodgings in advance. The efforts made to attract buyers may be estimated from the fact that at the present time the hoardings of Brussels are placarded with advertisements of the forthcoming Fair at Prague, a city which cannot be reached in less than twenty-four hours in an express train and where no language but Czech or German is commonly understood. When the same logical principles which are leading to the rationalisation and consolidation of industries are applied to the problem of getting and keeping in touch with foreign buyers, it is hardly to be doubted that the tendency of manufacturers will be more and more to concentrate their efforts on an annual national exhibition sufficiently important to attract regular foreign visitors, instead of dissipating them in small or infrequent shows of which the effect is slight and transitory. The Germans, whose business instincts are undeniable, have for the most part chosen Leipzig Fair as the occasion of their annual demonstration. The motor car industry still stands aloof, it is true, preferring, as in most other countries, to have a fashionable exhibition of its own in the capital ; but it is possible that when the need for foreign business is felt more acutely the advantages of Leipzig may prove too strong to be disregarded. Already the heavy commercial vehicle section of the trade has come into line, a vast new hall, constructed since the last Fair, now housing an imposing display. The machine tool builders decided to make use of Leipzig several years ago, and they have not only built for themselves the most striking exhibition hall in the whole of the Fair, but fill it every year with machines in motion, ranging up to the largest yet constructed. The cost of bringing some of these machines right across Germany and erecting them in working order must be immense. Yet as the effort is repeated year after year, there is no doubt that the benefit to German trade and prestige is found to be greater. The overseas buyer, coming from the British Industries Fair at Birmingham, where practically not a machine tool is to be seen, and noting the German display at Leipzig, cannot be blamed if he takes the respective shows as representative of the relative development of the machine tool industry in the two countries. The existence and the growing importance of these national Fairs on the Continent places several problems before the British manufacturer. In the first place, should he take advantage of the assembly of so many buyers to exhibit his own goods ? In this connection it must be remembered that, even when a Fair advertises itself as "International," the organisation is primarily for the benefit of the home industry. No British machine tool would be admitted to the Machine Tool Hall at Leipzig, for example, as the hall is restricted to the use of the German Machine Tool Trade Associations. Such foreign firms as do show at Leipzig are for the most part segregated into halls or rooms restricted to exhibitors of their own nationality. One finds them by seeing the national flags outside. In the technical section, with which our readers will be most concerned, there are no foreign national collections at all, with the exception of a sort of large bungalow devoted to the Bolshevist Government. Such non-German firms as do exhibit are intermingled with the German firms without discrimination. Two British textile machinery makers are showing this year in one of the halls, a well-known firm of British machine tool makers have a stand elsewhere, though not, of course, in the main machinery hall, and a few others are to be found exhibiting either under their own name or under that of their German agents.

Whether or not it would pay a British firm to exhibit under the conditions ruling at continental Fairs is a question which can only be answered for each individual firm and each particular Fair.

It is certainly of the highest importance that the question should be studied—not by reading the attractive literature of the Fair organisation, but by the visit of a qualified commercial man to the Fair itself. If, after that, any doubt remains, the experiment is worth making, for all the seed cannot fall on stony ground, and for a firm to get itself and its products better known is the first step towards extending its business. Since the inauguration of the British Industries Fair, however, the British manufacturer has had an alternative means of getting into touch with the foreign buyer. Buyers will come to Birmingham as freely as to Leipzig if there is anything worth seeing when they get there. Machinery can be sent there by road or rail much more cheaply than it could be shipped to a continental exhibition, and the expenses of representation are far less in other respects. To wait until the Birmingham Fair is comparable in size with that of Leipzig, with centuries of history behind it, is a foolish policy. The technical part of the Leipzig Fair is only about the same age as that of Birmingham, and competition with it is easily possible. In many respects, indeed, the Birmingham organisation is superior, the catalogue, for example, being incomparably better. If the British manufacturers and trade societies concentrated their efforts on one great annual show at Birmingham, as the German manufacturers do for their Technical Fair at Leipzig, it is likely that their foreign trade would soon show a comparable expansion. "*Fas est et ab hoste doceri.*"

Electricity Supply.

A VOLUMINOUS return of engineering and financial statistics relating to authorised electricity undertakings in Great Britain and covering the year 1925–1926 has recently been issued by the Electricity Commissioners. Like its predecessors, it is composed mainly of tables, but the compilers have included a summary of the principal features, which throws an interesting light on the electricity supply business. The return covers all local authority undertakers in England and Wales holding statutory powers of supply at March 31st, 1926; all local authority undertakers in Scotland holding such powers at May 15th, 1926; and all company undertakers in Great Britain with powers at December 31st, 1925. The stage of development attained by the public supply undertakings in Great Britain in 1925–1926 is shown by average figures per head of population in 1925. The sales of electricity by all authorised undertakers during the period reviewed represented an average consumption of approximately 128 units per head, as against 82 units for the year 1920–1921. Progress is also indicated by the addition to plant capacity, which amounted to nearly 700,000 kW, as compared with an average increase of 300,000 kW in the five preceding years. Needless to say, the Government's policy is resulting in a considerable increase in the use of large turbo-generator sets, but the task of eliminating relatively small stations is not being carried out with great rapidity. During the period considered 491 generating stations were operated by authorised undertakers. In the aggregate these stations contained 4,421,602 kW of generating plant, of which upwards of 98 per cent. were steam driven. Fifty per cent. of this plant was, however, contained in 52 stations, each having an installed capacity of 25,000 kW or over, whilst the remaining 43 per cent. was distributed between the other 439 stations, of which 205 had an installed capacity of less than 1000 kW each. Much remains to be done, therefore, before the Government's intention to concentrate all the plant in a few large stations is realised.

By far the larger part of the new plant installed during 1925–1926 was, of course, designed for generating alternating current. Over 91 per cent. of this plant was, in fact, alternating-current plant, constructed for fourteen different frequencies. About 77 per cent. of the plant was, however, for the accepted standard frequency of 50 cycles per second. Although the standardisation of frequency is part of the Government's scheme, the installation of non-standard plant continues at a by no means insignificant rate. At least one large station recently put into operation, namely, the Stourport station of the Shropshire, Worcestershire and Staffordshire Electric Power Company, is designed for a frequency of 25 cycles per second. As compared with the position at the end of 1924–1925 there was an increase of 556,567 kW in the amount of 50-cycle plant installed and an increase of 150,582 kW of non-standard plant, a portion of the increase in both cases being accounted for by changes in the rating of existing plant from the most economical output to the maximum continuous rating. If to the task of standardising frequency we add that of diminishing the number of voltages it is seen that this business of standardisation is a somewhat troublesome one. The diverse character of the declared voltages in force at the end of the period covered by the return is indicated by the fact that low and medium-pressure supplies at voltages ranging from 100 to 480 were being given at no fewer than thirty-three different voltages in the case of alternating-current supplies and at twenty-four different voltages in the case of direct-current supplies, the total number of declared voltages within the range in question for both classes of supply taken collectively being thirty-eight, these figures including associated pairs of voltages. Such diverse conditions of supply are naturally reflected in the manufacture of electrical plant and equipment, owing to the number of types or ranges of machines required by undertakers and consumers alike. Standardisation is no doubt a thing to be aimed at, but it will be many a long day, we fancy, before anything like complete uniformity is secured. The statistics for the aggregate and average consumption of fuel indicate that economies continue to be effected in the utilisation of fuel at steam-driven stations. The analyses of the average costs of generation given in the preceding returns serve to emphasise the effects of fuel economy and fuel costs upon the working expenses of authorised undertakers and hence upon the prices at which energy can be supplied to consumers, although we must confess that we have not noticed a very general appreciation of this fact. On the contrary, the tendency appears to be to complain about the high prices that are being charged. The average revenue obtained per unit sold, however, during 1925–1926 is said to have shown a reduction in the case of every class of supply, thus maintaining the progressive downward tendency recorded in this direction in each year since 1921–1922. The general average in 1925–1926 for all classes of supply taken collectively was over 33 per cent. lower than the corresponding figure for 1921–1922.

To those who understand all that is involved in bringing down the price of electricity this reduction is perhaps satisfactory, but unfortunately the public has been led to suppose that in the near future everyone will obtain electricity for next to nothing, and the outcry against some of the high prices prevailing is scarcely to be wondered at. Even when all the work that is contemplated has been undertaken some electricity consumers will have to pay more than others, for price is affected by local conditions. Some authorities go as far as to say, in fact, that many consumers will have to pay more for their current than they are paying at present. Capital expenditure on transmission is looked upon by many as the main drawbacks to the Government's super-power scheme. The erection of large stations may reduce the cost per kilowatt installed, but owing to the distances over which the current has to be transmitted this may be no real advantage. The present return contains a good deal about capital expenditure, but we should like to have seen definite figures relating to stations such as Barking, which was one of the large stations set to work during the period covered by the return. More than 56 per cent. of the capital expenditure during 1925–1926 was in respect of transmission. distribution, &c., the proportion being somewhat larger in the case of companies than of local authorities. Whilst in the past the capital cost and working expenses of generating stations seemed to be regarded as the only things that really mattered, cheap distribution now claims attention. Unfortunately, however, even to-day some supply undertakings still indulge in expensive methods and show no inclination to curtail the practice of distributing direct current. It is reported this week, for example, that one of the London companies is spending £45,000 on a 3000-kW automatic sub-station, which is more than the Stockport Corporation is paying for its new 20,000-kW turbo-generator set. Another matter that would seem to call for attention is the amount of loss that occurs between the generating stations and the consumers' premises. Of the total public supply during 1925–1926, 81 per cent. was sold to the consumers, the remaining 19 per cent. being accounted for by the works requirements of the undertakers and by losses in transmission and distribution, &c. Any appreciable reduction in the amount of power used in generating stations may not be possible, but there is not much doubt that many units are lost in the process of conversion. It is a pity, in our opinion, that the Commissioners have no control over distribution, for whilst some engineers seem to strive their utmost to cut down distribution expenses, others seem to take a pride in perpetuating a system that is inflexible and costly.

Levelling with an Aneroid.

By Colonel Sir GORDON HEARN, C.I.E., D.S.O., Royal Engineers (Retired).

No. II.*

AIR is a gas and subject to dilatation or increase of volume, if heated. Whether it diffuses readily the writer ventures to doubt. By strict injunctions on opening doors and windows, unless the temperature outside the house was less than the temperature inside, he has been able for weeks to keep the inside temperature down to 93 deg. Fah., whereas the outside temperature has risen as high as 120·4 deg. in the shade. On the other hand, after rain and a considerable drop in the outside temperature, it has taken more than twelve hours to reduce the inside temperature to the same level with all doors and windows open. At least it would appear that air does not communicate its heat to the surrounding air readily.

"The Dictionary of Applied Physics" deals exhaustively with the thermodynamics of air and with results obtained from observations of the upper air. To go into all these matters is unnecessary, but the engineer should have some idea of the conditions. And the writer has some observations to make on these conditions as the result of experience.

To what height above the surface the air extends is a matter for speculation, but it is far above the height attained by any aeroplane, 38,000ft. over Italy. Various observations have been made by balloons, containing either observers or self-recording instruments. Gay Lussac in 1804 attained an estimated height in a balloon of 22,896ft., and in 1852 Welsh ascended very slightly higher. The Mount Everest expedition of 1922 ascended to 27,300ft.

It is known, however, that the air above the surface has certain temperature characteristics. Up to a certain height the temperature falls at certain "lapse rates" with certain increments of height, and this envelope of air is called the troposphere. This probably averages in thickness 50,000ft. at the Equator, 33,000ft. above Europe at a latitude of 50 deg., and rather less further north. Above this, up to a height of 75,000ft., comes an envelope in which the temperature varies very little, and this is called the stratosphere. From the engineer's point of view it is a great pity that these conditions are not reversed, for his troubles arise from changes of temperature, especially near the ground.

The thickness of the troposphere increases in summer and decreases in winter, according to "The Dictionary of Applied Physics," is thick over anticyclonic areas and thin over cyclonic. In the writer's experience there is a lower pressure in the summer months in the tropics than in the winter.

He has records of the daily pressure at Peshawar, latitude 34 deg. North, indicating the following differences, the highest pressure occurring in January :—

February	−0·15	August	−0·90
March	−0·30	September ..	−0·45
April	−0·40	October	−0·30
May	−0·60	November ..	−0·20
June	−0·90	December ..	−0·10
July	−1·00		

The differences are calculated from the January pressure. In another year they were slightly different, the drop in July being slightly less, although the temperature was higher. At Calcutta also a distinct drop in pressure was experienced as the sun rose higher in the spring.

Theoretically, even if the air is expanded by heat, the coefficient of expansion for 1 deg. Fah. being ·002034, there would still be the same quantity of air in the column above the pressure gauge—that is, the barometer—and so it would seem that the air flows outwards from the Equator to higher latitudes, both seasonally and daily, as shown by the fluctuations called the "diurnal wave," to be examined later.

The density of the air is affected by the amount of water vapour in it, the weight of vapour being 0·622, compared with that of air. The quantity of water vapour is calculated by comparison of the wet and dry bulb thermometers, and may be very high near the ground in a morning mist. Usually vapour content increases with height. It is not really practicable to take account of this factor with any accuracy. although some correction may be made by estimation. The effect of the presence of much vapour is obviously to show a lower pressure difference for a given height, and possibly if a certain route is often traversed on the way to and from work, bench marks may be established for comparison of pressure readings. Later a table is given showing a number of readings taken between such bench marks in the Khyber Pass.

Assuming the air to be absolutely dry and to be isothermal, that is, to have the same temperature throughout the column above the instrument, there

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will be constantly decreasing differences of pressure for every thousand feet risen through the column, because there will be a smaller quantity of air in the remainder of the column above the instrument. The formula is :—

$$H \text{ (feet)} = 221 \cdot 1 \, T \, (\log. p_1 - \log. p_2) \quad . \quad (1)$$

T is expressed in degrees absolute Centigrade, 273 deg. being the freezing point of water, or 32 deg. Fah. The logarithms are to base 10.

If T be the mean temperature at the two stations, this formula can be used with close accuracy.

But the air is not isothermal. Normally, the temperature decreases with height at a certain lapse rate, although in winter there may be an inversion, colder air falling to the surface, sometimes by sliding down mountains, as in the Himalayas. In summer in the tropics for the first two or three thousand feet above the surface, there may be some extraordinary lapse rates, the air being highly heated by the effect of the sun on the ground and rising rapidly. This is shown by soaring birds, which take to the air an hour or two after sunrise, and with hardly a flap of the wing can circle over the ground searching for their food. The writer observed on the Gomal River two large lammergiers moving backwards and forwards along a precipitous cliff, soaring all the time, and has also watched the kites soaring about at the head of a valley facing east in the Khyber Pass for hours at a time. The ascensional currents are so great in this neighbourhood that aeroplanes are lifted on approaching the hills, while the range of guns is increased. Sir Alan Cobham has recently reported this lifting action while passing over an area of grass fires in Africa.

It is generally taken, as agreed at Innsbruck in 1905, that the lapse rate is a decrease of temperature of 3 deg. Fah. per thousand feet for the first 10,000ft. above the surface. In the first 3000ft. the rate may be 6 deg. per thousand and even higher in the first few hundred feet. Thus, in the Khyber Pass, falls in temperature of 5 deg. and even 10 deg. have been observed in a rise of about 300ft. In France a rate of 1 deg. Cent. has been observed in 160 m. in summer. 180 m. in autumn, and 200 m. in winter. It is very desirable that the observing stations shall be fixed in as open ground as possible, so as to avoid vitiations of readings owing to the proximity of heated ground or rocks or buildings.

The following table shows the results of seven readings taken in the Khyber Pass, the first two being taken between heights of 3518 and 3233, and the other five from a bench mark near the second of these two, but the actual value of which has been mislaid.

Station.	Date.	Times.	Diff. of pressure.	Temp., Fah.
Summit ..	26/8/19 ..	8·45 ..	..	82
A	..	9·15 ..	·26	83
A	..	18·55 ..	..	90
Summit ..	..	19·05 ..	·24	86
Summit ..	27/8/19 ..	14·10 ..	..	86
A	..	14·40 ..	·26	96
A	..	17·17 ..	..	96
Summit ..	..	17·45 ..	·27	92
Summit ..	28/8/19 ..	14·20 ..	..	86
B	..	14·40 ..	·26	96
Summit ..	29/8/19 ..	9·20 ..	..	82
B	..	9·45 ..	·30	86
B	..	11·50 ..	..	92
Summit ..	..	12·10 ..	·24	85
Summit ..	3/9/19 ..	7·10 ..	..	77
B	..	7·35 ..	·28	76
B	..	10·10 ..	..	86
Summit ..	..	11·00 ..	·29	82
Summit ..	7/9/19 ..	11·40 ..	..	81
B	..	11·55 ..	·30	87
B	..	13·50 ..	..	91
Summit ..	..	14·10 ..	·31	84
Summit ..	12/9/19 ..	10·30 ..	..	81
B	..	11·00 ..	·29	85
B	..	12·50 ..	..	91
Summit ..	..	13·10 ..	·29	86

It will be seen that only the early morning readings give reasonable lapse rates, and that, apart from probable errors in barometer readings, it would have been advisable to take the temperature at the higher and more open station as the true temperature of the air column, instead of taking the mean.

The following formula is based on a temperature gradient of 6·5 deg. Cent. per kilometre, or 3·55 deg. Fah. in 1000ft.:—

$$H \text{ (feet)} = 505 \, T_1 \, [1 - (p_2/p_1)^{\cdot 1804}] \quad . \quad . \quad . \quad (2)$$

T_1 is the temperature at zero height in degrees Centigrade absolute.

This formula may be suitable in some cases, but is tedious to calculate, the lapse rate must be uncertain and the temperature is almost certain to alter during the time of transition from one station to another. The formula (1) can be readily calculated by means of tables, absolute degrees being converted into degrees Farhenheit ; 273 deg. absolute is 32 deg. Fah., and 5 deg. Cent. equal 9 deg. Fah.

The coefficient in formula (1) $221 \cdot 1 \times 273 = 60{,}360 \cdot 3$ at 32 deg. Fah., and should be multiplied by T/273 for every degree Centigrade, or 9/5 deg. Fah. above 32 deg. Fah. But if the instrument has been graduated for 50 deg. Fah., corresponding alterations should be made in the tables used, and the factor will be T/283.

Laplace, in his "Mecanique Celeste," gave a coefficient of 60,368·6, with a number of other coefficients for latitude, mean terrestrial radius, and gravity, beside the coefficient for expansion of the air by heating. This formula was accepted by the Meteorological Congress at Rome in 1879, but the majority of the coefficients are eliminated in using the aneroid. The main factor log. p_1/p_2 finds universal inclusion in formulæ.

Strictly speaking, this formula is only applicable to observations taken instantaneously at two points in a column of air directly above each other—an impossible proposition, except in the Eiffel Tower or a skyscraper—but, after a good deal of discussion, it has been accepted by the Air Ministry, and altimeters can be set to zero before starting to fly to a certain height or to the known level at the air station. If a self-recording barograph is carried in an attempt to beat the height record, the formula is applied to the record traced, with a pressure temperature ratio. In ground surveying, of course, the pressures and temperatures read apply to two different air columns, and later simultaneous records taken at Peshawar and Landi Kotal will be examined.

The coefficient given in formula (1) does not include any allowance for humidity, which, as mentioned above, would give a greater difference of height for a given difference of pressure, apart from temperature considerations. It has been agreed to omit this factor in reducing pressure to mean sea level in weather charts for stations of an altitude under 3000ft. But the United States Coast and Geodetic Survey report of 1881 included a humidity allowance in the temperature correction in the formula—

$$E \text{ (elevation in feet)} = 60{,}521 \cdot 5 \, (1 + \cdot 001017 \times 36^\circ \text{ Fah.}) \log. 30/p,$$

for an average temperature of 50 deg. Fah. For other temperatures, substitute $(t_1 + t_2 - 64^\circ)$ for 36°.

The table given for the coefficient in brackets is as follows, $t_1 + t_2$ being the sum of observed temperatures at the two stations in degrees Fahrenheit.

80 — 1·017	140 + 1·047
90 — 1·006	150 + 1·058
100 + 1·005	160 + 1·068
110 + 1·016	170 + 1·078
120 + 1·026	180 + 1·088
130 + 1·037	

Interpolation between these values is sufficiently accurate. This applies to instruments graduated for 50 deg. Fah.

In Whitelaw's "Surveying" the temperature coefficient for degrees Fahrenheit is—

$$[1 + (t_1 + t_2 - 64)/900]$$

for instruments graduated for 32 deg. Fah. This is on the high side.

It will be seen that there is some difference of opinion as to what pressure shall be taken as mean pressure at mean sea level. In the American formula it is taken at 30in. Laplace calculated it at 29·9218in. In modern meteorological charts 1000 millibars = 750·1 mm. = 29·531in. at 32 deg. Fah., whereas the American formula is based on 50 deg. Fah. Sir G. B. Airy, former Astronomer Royal, in 1867—see "Proc.," Met. Socy., Vol. III.—framed a scale based on a pressure of 31in. at 50 deg. Fah. This scale is frequently engraved as the feet scale on aneroids. At 32 deg. Fah. it would be reduced by 36ft. per thousand.

Airy's formula employed a coefficient of 62,759, and allowed about 0·3ft. per 100ft. for average humidity of the air. The coefficient used in graduating altimeters is—

$60{,}368 \text{ T}/273 = 62{,}759$, if T = 283, *i.e.*, 50 deg. Fah.

Pressure at mean sea level, however, is seldom the mean, and Mr. Rollo Appleyard in a paper to be found in Vol. 196, "Min. Procs.," Inst. C.E., has investigated the readings which would correspond to different presures at M.S.L., using a coefficient of 60,355.

True height feet.	Barometric readings corresponding to different pressures at M.S.L.			
M.S.L. ..	28·00 ..	29·00 ..	30·00 ..	31·00
1000 ..	26·95 ..	27·91 ..	28·88 ..	29·84
2000 ..	25·94 ..	26·87 ..	27·80 ..	28·72
3000 ..	24·97 ..	25·86 ..	26·76 ..	27·65
4000 ..	24·04 ..	24·89 ..	25·76 ..	26·61
5000 ..	23·15 ..	23·97 ..	24·80 ..	25·65
6000 ..	22·27 ..	23·07 ..	23·86 ..	24·66

Thus, if the pressure at M.S.L. be 28·00in., a rise from 1000 ft.to 3000ft. should show a pressure difference of 1·98in. If the M.S.L. pressure were 31in., the same rise would show a pressure difference of 2·19in., corresponding to a difference in height of 200ft.

The following is a comparison of the pressures given by Laplace, Airy, the U.S. Survey and those used for graduating altimeters, all being for a temperature of 50 deg. Fah. The first and last are for dry air, the two intermediate allow for humidity.

Height.	Laplace.	Airy.	U.S.	Altimeter.
M.S.L. ..	29·82 ..	31·00 ..	30·00 ..	29·90
1000 ..	28·80 ..	29·98 ..	28·88 ..	28·82
2000 ..	27·71 ..	28·81 ..	27·88 ..	27·78
3000 ..	26·69 ..	27·77 ..	26·88 ..	26·78
4000 ..	25·68 ..	26·77 ..	25·90 ..	25·81

In the U.S. scale, a fall of pressure from 30in. to 29in. represents a rise of 924ft., while a fall from 26in. to 25in. represents a rise of 1069ft. No temperature correction, of course, is applied. It is apparent that, if the base line of the scale alters, there is a risk of faulty deduction from the readings. And the base line may vary by 1in. or 2in., as has been shown, in abnormal or seasonal variations, apart from the diurnal variations, which will now be examined.

(To be continued.)

Literature.

SHORT NOTICES.

Wireless Direction Finding and Directional Reception. By R. Keen. London: Iliffe and Sons, Ltd. Price 21s.—The second edition of this well-known book which was originally entitled "Position Finding by Wireless," contains a lot of new and up-to-date information. The theory of direction finding is dealt with more fully than it was originally, and rotating frame systems of direction finding and beacon transmitters are now considered. Many important aspects of the subject are dealt with, such as suitable installations for work on shore, on ships and in the air. Night effect and other freak phenomena, fault clearing and maintenance are other matters which the author discusses. The chapter on valve amplifiers has now been omitted. The section on "Field and Nautical Astronomy" has been re-written, so as to include a variety of methods of finding the direction of the true north, experience having shown that this information is of considerable use in direction-finding work and directional reception. We believe that there is no other book published in this country that deals with the subject of direction finding and directional reception exclusively, and although it may not appeal to the bulk of people who are now dabbling in wireless matters, it should prove of great value to those who specialise in this particular branch of the subject.

American Railway Signalling Principles and Practices. Chapter V., Batteries, and Chapter X., Alternating-current Relays. Published by the American Railway Association, Vesey-street, New-York. Price, Chapter V., 20 cents to railway employees, 30 cents to others; Chapter X., 15 cents to railway employees, 25 cents to others.—These monographs, in paper covers, form two more of the contemplated twenty-six chapters in which the whole subject defined in the title is to be covered. Chapter VI. appeared last May. The two chapters now before us are admirably done. They are essentially practical, being descriptive of the appliances named, with clear instructions concerning their use. Both are illustrated by diagrams, drawings, and a few half-tone blocks. We have found Chapter X., Alternating Current Relays, particularly interesting. It opens with a very lucid account of the principles involved, and then describes the various types of such relays in general use. The pamphlets may be recommended, not only to engineers engaged in signalling, but to young electrical engineers who want really practical handbooks.

Continuous Current Engineering. By Alfred Hay. London: Constable and Co., Ltd. Price 14s.—This book was first published in 1907 and the present volume is the third edition. Like its predecessors, it is not intended for advanced students. Elementary methods of treatment are made use of throughout, and no attempt is made to cover the entire field of continuous-current engineering. The aim of the author has been to present the reader with a simple and by no means exhaustive account of the component parts of continuous-current lighting and power plant, dynamos, motors, secondary cells, measuring instruments, &c. This new edition has undergone considerable revision, much new matter has been added, and certain sections have been practically re-written, whilst others dealing with types of machines and apparatus that have become obsolete have been omitted.

Electrical Engineering Economics. By D. J. Bolton. London: Chapman and Hall, Ltd. Price 21s.—The aim of this book is to give electrical engineers and students a plain account of such elementary economics as most nearly concerns them. The book is divided into three parts, the first of which deals with general principles, the second part is devoted to the general problem of economic choice, whilst the third part is concerned with some of the economic problems connected with electricity supply. In most of the chapters the principles enunciated are capable of immediate application to electrical engineering problems, and a number of worked examples and illustrations are given. Many of the decisions that have to be made by engineers concern cost just as much as performances, and the book seems to fill a real want.

BOOKS RECEIVED.

Practical Television. By E. T. Larner. London: Ernest Benn, Ltd., Bouverie House, 154, Fleet-street, E.C. 4. Price 10s. 6d. net.

Costs for Manufacturers. By Charles Smith. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 5s. net.

"*The Wireless World*" *Moving Coil Loudspeaker.* London: *The Wireless World*, Iliffe and Sons, Ltd., Dorset House, Tudor-street, E.C. 4. Price 1s. 6d. net.

The Year Book of Scientific and Learned Societies of Great Britain and Ireland, 1927. London: Charles Griffin and Co., Ltd., 42, Drury-lane, W.C. 2. Price 18s. net.

The Accuracy of Commercial Screw Threads. By T. H. Rolt and W. G. Ridge. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. 3d. net.

The Mineral Resources of the United States, 1924. *Part I, Metals ; Part II., Non-metals.* By F. J. Katz. Washington: Department of Commerce, Bureau of Mines, U.S.A. Price 1 dollar each part.

The Thring High Pressure Indicator.

THE indicator illustrated herewith has been designed by Mr. Leonard G. P. Thring to give a complete record of the pressures that occur in the barrel of a gun or rifle during the explosion of the charge from the commencement of ignition until after the bullet has left the muzzle.

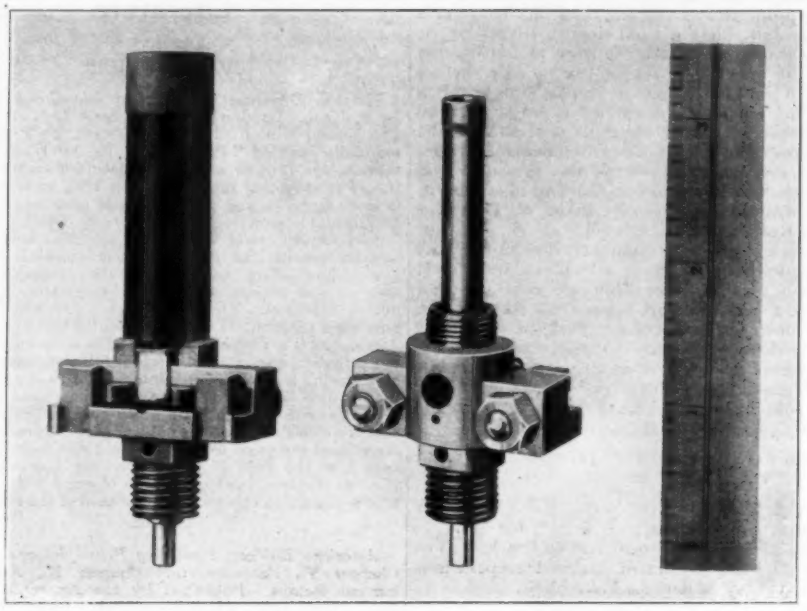


FIG. 1—THE THRING PRESSURE INDICATOR FOR GUNS AND RIFLES

In a modern rifle the time that elapses from the beginning of the explosion to the point of maximum pressure is about four ten-thousandths of a second, while the pressure may reach 50,000 lb. per square inch, so that, comparing the problem with that involved in indicating an internal combustion engine, the ratio between the times occupied by the rise of pressure is of the order of 1 : 50, while that between the pressures is of the order of 100 : 1. It is because of these factors that the gun, although the earliest example of an internal combustion engine, is the last to be provided with an indicator.

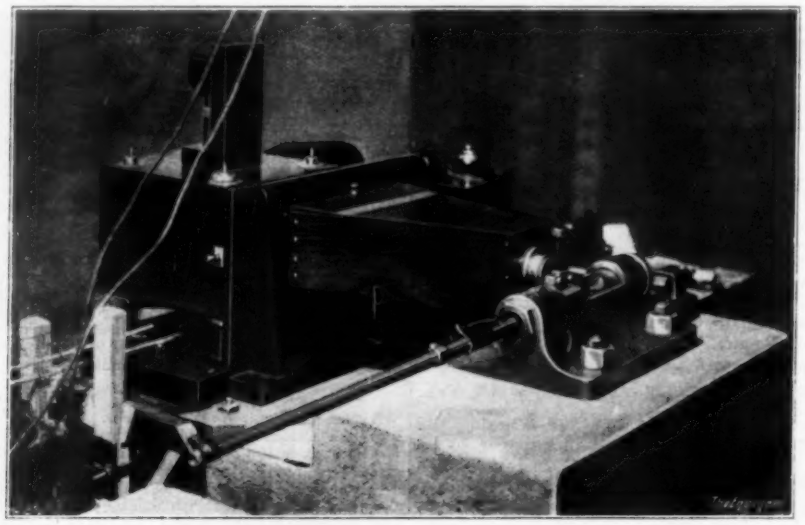


FIG. 2—INDICATOR MOUNTED ON A RIFLE BARREL

The instrument is shown in Fig. 1 from the front and the back, and mounted in position on a rifle in Fig. 2. The diagram, Fig. 3, shows a section through the axis in a plane at right angles to the mirror M. The mirror is mounted at the centre of a steel strip S, which is rigidly connected at either end to the body A. The latter is screwed firmly to a tube B, the lower end of which is enlarged and threaded to form a plug that screws into a breech piece surrounding the rear end of the gun barrel, as shown in Fig. 2, while the upper end is connected to an inner tube C. This tube is closed at the lower end, forming a small plunger P, which exactly fits a hole in the gun barrel, a corresponding hole being bored in the wall of the cartridge case to register with it. When a shot is fired, the powder pressure, acting below P, forces the latter up by an amount equal to the sum of the compression of the tube C and the extension of B. This movement is proportional to the pressure, both tubes being of high tensile steel, and is transmitted to the end E of an arm E S extending behind the mirror by means of a strut G, thus causing the mirror to tilt through a small angle.

To eliminate any play between the moving parts which would lead to serious inaccuracy in the records, as the whole movement of the plunger is less than a fiftieth of an inch, care has been taken to avoid variable surface contact between adjacent parts. The small movements necessary are all obtained by designing the connections to allow of elastic deformation in the directions required, while being rigid in all other directions. Thus the axis about which the mirror rotates is the centre line, passing through S, of a spring strip capable of torsional deformation, but rigid in the direction of motion of the plunger. The angular movement between the mirror arm and the strut is similarly rendered possible by clamping the latter to the centre of a light frame of spring steel F, kept in tension by a nut H, which is also threaded on the outside to engage with the top of the strut G.

The movement of the mirror is registered as in other optical indicators by causing it to reflect a bright spot of light which is brought to a focus on the surface of a drum mounted inside a camera with its axis parallel to that of the instrument. The drum has a length of photographic paper stretched round its circumference and is revolved at any required speed by a motor. The general arrangement can be inferred from Fig. 2.

The diagrams thus obtained are pressure-time diagrams, the base representing time. The diagrams reproduced in Figs. 4 to 7 have been chosen to show the very short natural period necessary for an instrument, if it is to give a correct representation of the pressures in a service rifle during discharge, and also to illustrate the characteristic burning of cordite under these circumstances.

Fig. 4 represents a very heavy charge of M D 4½ cordite, and was taken with the earliest model of the indicator, which had a natural period of vibration of ·0002 second. The sharp peak at the top shows that the period of the instrument was not short enough for it to deal adequately with the rapid rise of pressure. The top of the peak does not give a true value of the maximum pressure, but is affected by the vibrations set up in the instrument by the rapid rise. These vibrations continue and can be clearly seen along the curve of expansion. The great improvement effected in a later model having a period of ·00007 second, or just over one-third that of the first instrument, is indicated in Fig. 5, which shows two diagrams taken on the same film at Cambridge, and forming two out of a series of four successive records of service charges which appeared to be identical within very narrow limits when tested by fitting each negative to the same print. These diagrams

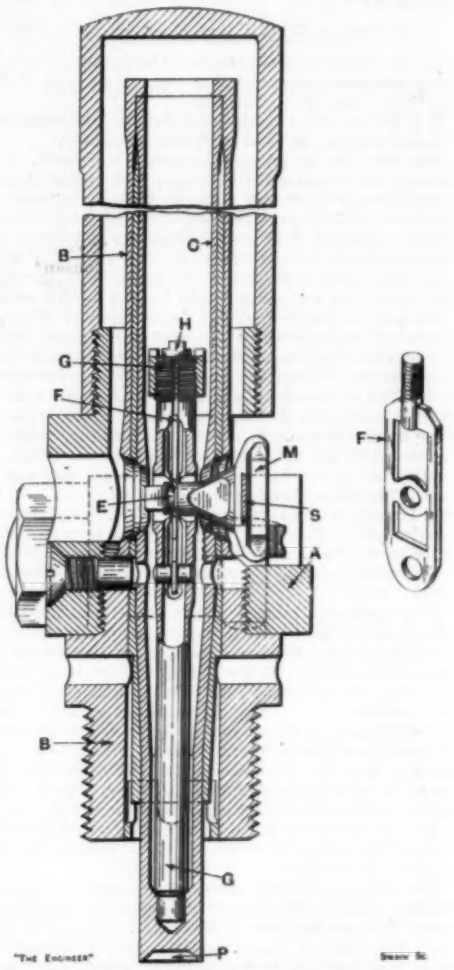


FIG. 3—SECTION THROUGH INDICATOR

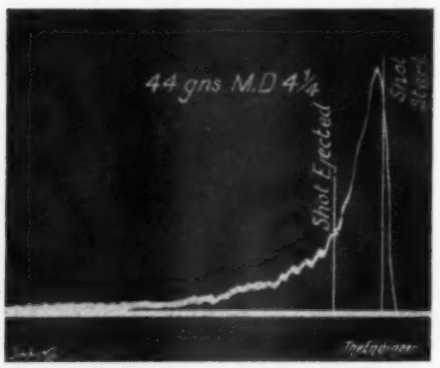


FIG. 4

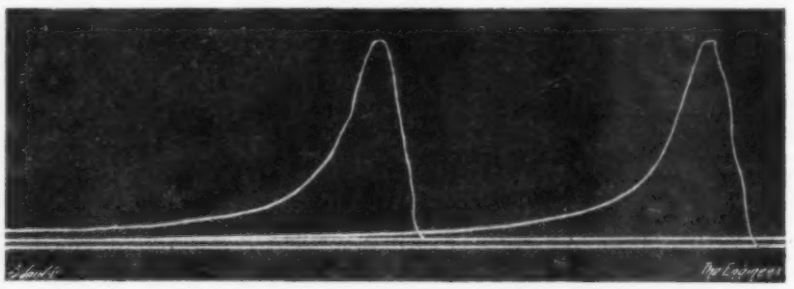


FIG. 5

show the flattened top characteristic of the combustion of cordite in a gun barrel. The corner at the right marks the point at which the rate of combustion is just sufficient to make good the increase of volume in the barrel produced by the motion of the bullet, while the corner at the left marks the point at which combustion is nearly complete, after which the expansion curve begins. Fig. 6 shows a record of a service charge taken at Messrs. Nobel's factory at Ardur with the same instrument. The vertical line on the right shows the moment at which the bullet left the muzzle, the time taken from the point of ignition

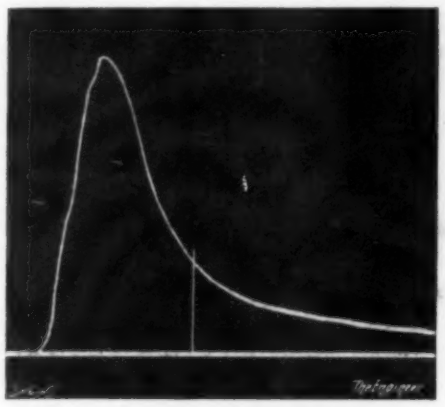


FIG. 6

being ·00115 second. It is interesting to note that there is no sudden drop of pressure recorded at this point, the inertia of the gas between the muzzle and the breech being sufficient to prevent the release of gas at the muzzle from affecting the pressure at once, the effect on the curve being only apparent in a slight flattening occurring a little further to the right. The vibrations of the instrument are apparent on that part of the curve on the left, showing the rise of pressure. The initial cause appears to be due to the instantaneous impulse given by the cap, but the vibrations are usually more apparent when the barrel is dirty. These diagrams when the point of departure and velocity of the bullet are known, can be used to determine the amount of energy lost by the friction of the bullet in the barrel, a subject on which but little is known at

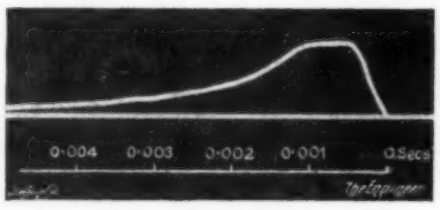


FIG. 7

present. Fig. 7 shows a low-pressure diagram obtained with a very light charge, and is interesting as illustrating the prolonged period during which the pressure is nearly constant.

This instrument is made by C. F. Casella and Co., Ltd., 49 and 50, Parliament-street, London, S.W. 1.

A Power Station for a Chemical Works.

THE following particulars of the contract it has secured for the plant of a new power-house have been sent to us by the Metropolitan-Vickers Electrical Company, Ltd.

Imperial Chemical Industries, Ltd., has recently placed an exceptionally large and interesting contract for steam turbines with generators and condensing plant with the Metropolitan-Vickers Electrical Company, Ltd., the contract having been awarded after severe international competition.

It will be recalled that Imperial Chemical Industries, Ltd., combines the well-known companies of Brunner, Mond and Co., Ltd., Nobel Industries, Ltd., the United Alkali Company, Ltd., and British Dyestuffs Corporation, Ltd., besides many other concerns, all associated in the manufacture of alkali products, acids, nitrogen products, explosives, ammunition, dyestuffs, fertilisers, paints, non-ferrous metals and alloys, and other kindred products.

The present contract is for nine turbo-alternator sets, with an aggregate output capacity of 93,000 kW—equal to 125,000 brake horse-power—to form the equipment of a new power station for a large chemical works now under construction for Synthetic Ammonia and Nitrates, Ltd., at Billingham, near Stockton-on-Tees.

The new power station will have a capacity appreciably greater than that of the famous Manchester Barton generating station, the equipment of which consists so far of three Metrovick 25,000-kW sets, and, as will easily be realised, the present contract is one of the largest for power plant ever placed in Great Britain.

The large scale on which the operations of Imperial Chemical Industries, Ltd., are conducted naturally creates a special outlook on power production problems, and therefore it is of interest to note that besides providing electric power supply in the new equipment, more than half the total steam to be generated will be used for manufacturing process work, having first of all passed through the high-pressure turbines.

Whilst the double use of steam, first to obtain electric power from turbo-generators and afterwards at a suitably reduced pressure for process work, is not new, the new installation will be of particular interest in that this system will be applied on an unusually large scale, and that the many problems involved in order to obtain from the coal consumed the greatest possible combined output in electrical power and in heat for process work have been worked out with great thoroughness.

The plant now ordered from the Metropolitan-Vickers Electrical Company comprises a total of nine turbo-alternator sets, three-phase, 40 cycles, 2400 r.p.m., 6300 volts, arranged as follows:—Three 12,500-kW M.C.R. primary sets, three 12,500-kW M.C.R. condensing sets, three 6000-kW M.C.R. feed heating sets. Two sets in each group will be working when the station is on full load, the other set in each group being used as a standby.

The primary turbines will be designed for operation by steam at a stop valve pressure of 630 lb. per square inch gauge, superheated to a total temperature of 833 deg. Fah., each set exhausting 5850 tonnes* of steam per day at a pressure of 275 lb. per square inch and a temperature of 662 deg. Fah. The electrical output under these conditions will be about 12,000 kW for each set, this being the service rating.

The exhaust steam from the primary sets will be led to a set of steam receivers, whence it will be distributed, the greater portion being taken to various parts of the chemical plant for process work, &c., some to the last stage feed heaters, and the remainder supplying the condensing and feed heating turbo-alternator sets.

As a standby, and to provide for any sudden increase in the quantity of steam required, a set of reducing valves with de-superheaters will be installed under a separate contract as by-passes to the primary turbines.

The feed heating turbo sets will comprise three feed heating turbines, three sets of five-stage vertical feed heaters, four sets of boiler feed pumps, three sets of heater drain pumps. The feed heating turbines are designed for operating with superheated steam at a pressure of 260 lb. per square inch gauge, and exhausting at a pressure a little below atmospheric.

The exhaust steam from these turbines will be led partly to the first stage feed heaters, and the remainder to the evaporating equipment which is being supplied under another contract. Three tapping points will be provided at the turbines from which steam is bled to the second, third, and fourth stage feed heaters, the fifth stage being, as already mentioned, fed direct from the receivers into which the primary turbines exhaust. The feed water heaters will be of the surface type, vertical pattern, fitted with float-controlled automatic by-passes.

Three sets of boiler feed pumps will be supplied, each equipment consisting of a low-pressure and an intermediate-pressure pump coupled together and driven by a motor, and a separate motor-driven high-pressure pump, a fourth boiler feed pump with a single feed water heater forming a standby. There will be three sets of heater drain pumps, comprising the necessary motor-driven extraction and lift pumps for removing the condensed heating steam from the heaters, each pump discharging into the boiler feed main after the heater which it serves. The whole of the pumps will be supplied by Mather and Platt, Ltd., as sub-contractors.

The considerable use of steam directly applied to chemical processes makes it necessary that the capacity of the evaporating equipment providing the necessary boiler feed make-up should be much greater than is usual with ordinary turbo plant. The whole of the make-up, together with the condensed steam returned from the various portions of the works plant, will be treated in de-aerators—not included in this contract—and thence pumped through the feed water heaters in which the temperature will be raised to about 400 deg. Fah.

The condensing turbines will utilise the remainder of the steam exhausted by the primary turbines and are intended to act as equalisers for the system. The conditions of service do not permit of fluctuations of load being carried by either the primary or the feed-heating turbines. All fluctuations in requirements of steam or electrical output, or of both together, will therefore be carried by the condensing turbo-alternator sets. Under the normal operating conditions of the plant the service rating of the condensing sets will be about 8000 kW, but each set will be capable of carrying 12,500 kW continuously, the alternators being duplicates of those for the primary turbo sets.

The alternators will be of standard Metrovick design. The six larger units will have a capacity of 15,625 kVA and the three smaller units a capacity of 7500 kVA. All the machines will be arranged for ventilation on the Metrovick patented closed-circuit air cooling system.

The whole of the plant has been designed on lines laid down by Mr. H. A. Humphrey, the consulting engineer to Imperial Chemical Industries, Ltd. It will be erected under the supervision of Mr. T. M. Wilson, chief engineer of Synthetic Ammonia and Nitrates, Ltd., and of Mr. D. M. Buist, the electrical engineer of that company.

* 1 tonne = 2200 lb.

Canadian Engineering News.

(From our own Correspondent.)

Hudson Bay Railway Ocean Terminuses.

When Mr. Frederick Palmer returned from Hudson Bay in August last he made a preliminary report, summarising the conclusions which led to his recommendation that Churchill be selected in preference to continuing at Nelson. The complete report, which has now been issued, amplifies the preliminary report and deals in greater detail with the reasons for the conclusion reached on the basis of physical conditions at both places, capital costs, time for completion, comparative annual charges, room for extension of initial harbour developments, and ice conditions. Mr. Palmer states that nothing of a permanent nature exists to-day of the work at Nelson other than the bridge superstructure leading to the partly completed artificial island. The crib piers and piles carrying the girders already show signs of decay, and would require to be replaced by permanent piers of concrete. The timber crib work of the island has also considerably deteriorated in the past ten years, during which the work has been closed down. The report emphasises the nature of the protection afforded by the sheltered harbour at Churchill, which renders storms innocuous, while borings show easy dredging instead of the solid rock work which former engineers had anticipated, and which was one of the factors leading to the previous selection of Nelson.

Mr. Palmer was asked to estimate the comparative costs of developing each port to a point sufficient to provide accommodation for six cargo vessels in port at one time, with working berths for three of the six, with estimated draught of not less than 26ft. To provide this initial test development at Nelson would, he finds, require 2,277,000 dollars for wharves; 4,038,025 dollars for breakwaters; 817,000 dollars for bridge pier cribs; 8,480,000 dollars for dredging; 1,007,000 dollars for aids to navigation; 722,000 dollars for dock equipment; 275,000 dollars for slipway and equipment; 2,000,000 dollars for grain elevator; and 60,000 dollars for the necessary harbour railway connection. To this total of 20,676,325 dollars is added 10 per cent. for contingencies, making 22,743,957 dollars in all. By contrast, the work at Churchill is estimated to cost 7,146,012 dollars, or, with the usual 10 per cent. added, 7,860,613 dollars. The main items of this total are:—Wharves, 2,530,012 dollars; dredging, 1,550,000 dollars; aids to navigation, 19,000 dollars; dock equipment, 697,000 dollars; slipway and equipment, 275,000 dollars; grain elevator, 2,000,000 dollars; necessary railway connections, 75,000 dollars.

Tidal Power Development.

The possibilities of tidal power development at Passamaquoddy Bay, and at Hopewell Cape, on the Petitcodiac River, in the province of New Brunswick, Canada, is a subject of live interest and discussion in the Dominion at present. Mr. Dexter P. Cooper, of New York, who is recognised as a foremost authority on tidal development in America, has spent not only a great deal of time, but a large amount of money in surveys and explorations at Passamaquoddy Bay, and at the present time he is conducting further surveys and explorations with a large staff of men, and will construct a barrage there at the possible cost of 100 million dollars. Mr. Cooper has also made several examinations of the Hopewell Cape site, and has given it as his opinion that a maximum horse-power output of 200,000 and a minimum of 100,000 can be developed, at an estimated cost of 23 million dollars. In statements made some time ago by one eminent English engineer and one German engineer, it was set forth that the most feasible and ideal tidal proposition in the world was at Hopewell Cape, on account of the junction of two rivers at that point. Mr. Cooper, however, has pointed out that it is quite impossible to arrive at any definite decision until complete data are available. In 1921 engineers of the Public Works Department of the Federal Government made borings across the mouth of both the Petitcodiac and Memramcook rivers to determine the depth of rock and the nature of overlying materials. Discussing the proposed Hopewell Cape scheme, Matthew Lodge, a director of the Canadian National Railway, which is interested in the project, said: "We must admit that more extensive borings and surveys at a great cost must be made before actual construction of a power barrage is undertaken." The company, lately incorporated by charter of the New Brunswick Government, is proceeding with the work as rapidly as circumstances will permit.

St. Lawrence Power Schemes.

An effort to arrive at some understanding as regards Canada's attitude towards the St. Lawrence power and navigation project was made at a series of conferences between the Federal Government and the National Advisory Committee in Ottawa during the first week in January. While no definite decisions were reached, two or three important features took shape. One was that much emphasis is to be placed upon the development by private enterprises of the power resources in the national section of the river between Cornwall and Montreal. Another was that, while steps will probably be taken towards opening negotiations between Canada and the United States to deal with the international section of the river between Lake Ontario and Cornwall, there is no evident disposition to hasten these steps, which means that the international features of the great project are really to be made secondary to the national. It is estimated that there is 2,900,000 horse-power available from the national section of the river, and that up to date only about 250,000 horse-power is being developed, most of it being consumed in Montreal. If private enterprise is to develop all the power in the national section of the river between Cornwall and Montreal, it is likely to be stipulated that undertakers are to be expected to contribute, either directly or indirectly, to the cost of deepening the waterway in that section and enlarging the canals. It now appears certain that the National Advisory Committee will not recommend a scheme costing 589,300,000 dollars, which was the amount estimated in the report of the Joint Board of Engineers, but a modified project, which will keep the cost down to less than 400,000,000 dollars. An eventual hydro-electric development of 5,000,000 horse-power can be made, but as there is no market for that amount of power at present, and will not be for probably fifteen or twenty years, it is likely that an initial scheme involving the development of something more than a million horse-power will be recommended. The United States engineers had a plan for a single-stage development in the international rapids section of the river, which would produce 1,365,000 H.P. at a cost of 350,100,000 dollars, while the Canadian engineers favoured a two-stage development yielding a similar amount of power at a cost of 385,000,000 dollars. This plan would entail less flooding of the low-lying lands.

INSTITUTE OF MARINE ENGINEERS.—The London Shipping Orchestral Society has very kindly arranged to give the proceeds of a forthcoming concert to the "Titanic" Engineering Staff Memorial Benevolent Fund, which is administreed by the Institute of Marine Engineers for the relief of necessitous widows and dependents of marine engineers. The concert will be given at Kingsway Hall on Wednesday evening, March 21st.

The Institution of Chemical Engineers.

Following the practice of holding two conferences a year instead of regular monthly meetings, the Institution of Chemical Engineers held a two-days' Conference at the New Princes Restaurant, London, on Thursday and Friday, March 8th and 9th. Originally, it had been intended that the Conference should fill three days, but for various reasons it was decided to curtail it. With the exception of one session, which was presided over by Mr. W. A. S. Calder (Vice-president), Sir Alexander Gibb (President)—who, by the way, has been elected for a second year of office—presided.

Magnetic Separation.

The first paper in the afternoon of March 8th was by Professor Bernard W. Holman, and dealt with the theory of magnetic separation. It presented a fairly exhaustive review of the subject, but did not profess to be more than a collection of notes on those parts of the theory of magnetism which the author has found useful in connection with magnetic separation. The paper was not intended to be an original contribution to our knowledge of magnetic separation, but in another paper published by the same author last August, certain new results were outlined, it being remarked that during the last twenty years remarkably little new work has been done on the magnetic behaviour of para-magnetic minerals. Professor Holman pointed out that in the general science of magnetism the tendency has been to pass from a molecular theory to an atomic theory. This transition has been greatly facilitated by the introduction of the quantum theory, but two fundamental difficulties are still unsurmounted, said Professor Holman, even by the ingenuity and flexibility of that theory. The first difficulty is the co-ordination of many of the associated phenomena of magnetism, such as the changes in shape and volume of materials on magnetisation and similar changes in conductivity and specific heat. The second difficulty is the fact that electrical and magnetic phenomena are very closely associated, and yet electricity demands the passage of free electrons from place to place in a circuit, while modern magnetic theory classes magnetism as a definitely atomic phenomenon. Hence, it comes about that some workers in the forefront of research are formulating a "free electron" or "electron atmosphere" theory of magnetism, which is being handled with the aid of the mathematical methods associated with "wave mechanics." At the same time, it is pointed out that without any abstruse elaboration or assumptions, many of the phenomena of magnetism can be dealt with by simple thermodynamics.

Dealing with the more practical side, Professor Holman said that larger capacity, absence of moving parts, minimum entrainment, greater range of application to weakly magnetic materials, successful wet treatment and more control of the response of the materials to magnetic forces are amongst the developments which are taking place in magnetic separators. The most desirable of all future developments, the drastic reduction of first cost for a given tonnage of finely crushed material treated, however, did not seem to be appreciably nearer. The new magnetic separator recently perfected by the Mond Nickel Company seemed to have solved the question of cheap treatment of lump material. A distinct advance in the treatment of fine material was marked by the invention of the magnetic grid by Dr. Stafford Hatfield, and of the almost knife-edge poles of the Davies non-entraining separator, which were further ingenious applications of the attraction principle. In Professor Holman's view, however, the most important future developments lie in the direction of improved magnetic repulsion separators.

Replying to the discussion, which turned mainly on theoretical questions, Professor Holman, referring to the difficulties still encountered in regard to magnetic separation, mentioned the case of a large contract for telescope lenses placed with a British firm. This contract has not yet been completed, and the firm, he said, has already incurred an expenditure of £25,000 on false melts because it has not yet found a successful means for separating the small amount of iron in the one-tenth of 1 per cent. of fire-clay which is in the silica crucibles, and in some way affects the final melt.

Powdered Coal.

In the evening of March 8th, a paper was read by Dr. Burrows Moore, in which a very detailed account was given of experiments upon the combustion of powdered coal. The experimental apparatus used has already been described, and the latest experiments carried out by the author may be summarised as follows:—The degree of fineness of the particles has been shown to affect considerably the rates of combustion, the ignition properties and combustible capacities of powdered coals, and the results indicate that there is a critical temperature and a critical degree of fineness at which the combustion of the particles becomes nearly instantaneous. This temperature corresponds with the glow point temperature, as determined by the Sinnatt and Slater method. The results show that above this critical temperature no very marked change in combustible capacity occurs, and it is suggested that in connection with the burning of powdered coal the use of charges of the critical degree of fineness and excess air at the critical temperature should ensure, theoretically, efficient combustion. The changes in the ignition and combustion properties do not depend merely on the surface area of the particles, but are related to their constitutions, which may vary during a pulverising process. The rate of combustion of a particle tends to decrease as the size increases and the effect of the larger particles on the reduction of the rate of combustion of a mass of powdered coal appears to be due largely to their relatively slower rates of oxidation and decomposition, and, to a less degree, to their interference with the propagation of heat between the smaller and generally reactive particles.

The annual general meeting of the Institution was held on Friday morning, March 9th, when Sir Alexander Gibb was re-elected President, and a generally satisfactory position was revealed. The membership is increasing and now approaches 500.

The Economics of Power.

Following the usual business of the annual general meeting, Sir Alexander Gibb gave an interesting address on "The Economics of Power as Applied to Chemical Engineering." The theme of the address was the position of cheap power as an essential part of electro-chemical and electro-metallurgical processes. After giving some typical figures of cost of electricity generated by water power in different parts of the world before the war, these varying from ·04d. to ·09d. per unit, Sir Alexander said the position is now materially different and that we shall never again see water power development on such a cheap scale. Whereas figures from £12 to £18 per H.P. of plant installed were common before the war in Sweden, France, Switzerland, Canada, and the United States, developments contemplated even in America and Canada to-day showed costs as high as £45 per H.P., and, generally speaking, in those countries where water power was available energy would only be purchasable in future at from ·07d. to ·145d. per unit to a nearby factory on the basis of a 100 per cent. load factor for the electro-chemical and electro-metallurgical industries.

In Great Britain, whilst he believed that the water power resources would eventually be found to be greater than those estimated by the Water Power Resources Committee, he feared that it would be very difficult to find sites of any importance capable of development at £40 per H.P. The average would be considerably higher and it would be over-sanguine to hope for any hydro-electric power plant in this country capable of producing at ·125d. per unit under the conditions he had taken. He put the lowest figure at ·16d. per unit. Whilst, however, we must reconcile ourselves to being not amongst the most favourably situated hydro-electric countries, we could draw some comfort from the fact that we have great coal supplies and that the margin between steam power and water power was much less now than it used to be. Before the war a figure of ·2d. per unit for the total cost of production, including all capital charges, had been reached in steam power stations. In the case of one large steam station with a particularly high load factor a supply of power for electro-chemical purposes had been given at ·16d. per unit. Those, he said, were admittedly exceptional cases, but since then the improvement in efficiency had been remarkable. With a 50 per cent. load factor electricity was being generated at the present time on a large scale at a switchboard cost of about ·275d. per unit, and he was confident that a modern 100,000-kW steam station in the most favourable circumstances could be built to produce electricity on the basis of 100 per cent. load factor at ·185d. per unit at the switchboard. In a year or two that figure would be reduced to ·175d. per unit. Moreover, the efficiency of the generation of electricity by steam was still comparatively low, and there was a corresponding opportunity for improvement, chiefly by the use of higher pressures and higher temperatures. A modern steam power station was already able to compete on a 100 per cent. load factor basis with a hydro-electric power station costing anything more than £65 per kW of capacity. As the load factor fell so the advantage of the steam power station became greater, and at 50 per cent. load factor only really cheap water power could compete.

When the best had been made of the position it might be felt that this country at the present time fell short of the requirements of the cheap power industries. If the matter ended there the outlook for many of the electro-chemical industries here would not be encouraging. Fortunately, however, there were other considerations. The more one considered the history of cheap power industries the more one must come to the conclusion that cheap power had been allowed to play a disproportionate part in their development. It was the fact that in some of the most important electro-chemical industries processes to-day were almost exactly the same as they were thirty years ago, and they entailed an uneconomic use of electricity. The profusion of cheap electricity had, indeed, to some extent been a disadvantage in that it had tended to remove the incentive to research and invention which otherwise economic factors would have forced. We could hardly ever hope in this country to have ultra-cheap hydro-electric power, but that should really be an encouragement to us. *Res angusta domi* was a useful spur to effort, and there were countervailing advantages and ways by which apparent disadvantages could be turned to profit by ingenuity. If electro-chemistry failed to advance, pure chemical methods would have increasing successes at its expense. The business of the chemical engineer was to take the best that existed and to improve on it, and only by doing so could he justify his existence.

Beet Sugar Effluents.

The final paper of the Conference, which was given in the afternoon of March 9th, was by Dr. O. Spengler, Director of the Institute of the Sugar Industry, Berlin, who dealt with the treatment of beet sugar factory effluents. The development of the beet sugar industry has brought with it some problems, not altogether unexpected, but not the least important is that of disposing satisfactorily and without nuisance of the effluent. Here we have the position of an industry, subsidised to a considerable extent by public money, but which might, under the common law of the land as regards nuisance, conceivably have to be shut down on this latter account. It is not suggested, of course, that such a position exists, but the fact remains that, not only in this country, but even in Germany, where much larger areas of land are available for the purpose, the disposal of the effluents from sugar beet factories is still a problem of special importance not yet completely solved. Therefore, the account which Dr. Spengler gave of German work in this connection is of special interest to this young industry in Great Britain. The magnitude of the task is seen in the statement that a factory with a daily capacity of 1000 tons of beets has to discharge something like 1,400,000 to 2,000,000 gallons of waste water. The simplest method of removing the effluents consists in the re-utilisation of the waste water. This involves no great expense, but the amount of organic acids increases, and contributes to the corrosion of the iron apparatus when the treated effluent is used as water for the battery, as has been tried. Hence, the re-utilisation process is used only in a very few places in Germany, and the greater part of the factories there are forced to discharge the effluents, which consist of diffusion and pulp press waste water, into the rivers, after careful clarification. A number of methods for treating beet sugar factory effluents was described in the paper, with the conclusion that every factory has to be treated in accordance with its own particular circumstances.

The matter, of course, is of particular interest here to those engineers who are responsible for the disposal of trade and other effluents, and it is receiving close attention from them and those associated with the beet sugar factories.

The Dinner.

At the annual dinner in the evening, at which the German Ambassador (Dr. Friedrich Sthamer) was the principal guest, Sir William Alexander, proposing "The Institution of Chemical Engineers," and speaking with regard to the training of chemical engineers, said that no degree in chemistry or engineering, however brilliant, must be considered by the holder to be sufficient qualification for the exacting profession of chemical engineering. It was at best a certificate of faithful preparation, and a degree must also be taken in the rough school of the workshop, of the works laboratory and of the manufacturing plant. The student who could add to this a practical knowledge of French and German need have no fear that his profession would prove an ungenerous mistress. Indicating some fields for the work of the chemical engineer, Sir William mentioned that the problem of organic solvents for cellulose lacquers is still in its infancy. The higher alcohols and esters of acetic acid, such as butyle and amyl acetates, the esters of phthalic acid, products such as diacetone alcohol and the glycol ethers, all required to be made in this country. The methods of preparation were known, but called for adaptation to industrial needs. The scrubbing of gases in a small plant of low cost and of high efficiency had still to be achieved. There were also the cognate problems of the recovery of solvents and the dehydration of tar without decomposition, and there was the field of liquid fuels obtained by synthesis or by hydrogenation. Low-temperature carbonisation, synthetic fibres and synthetic nitrogen products were also mentioned.

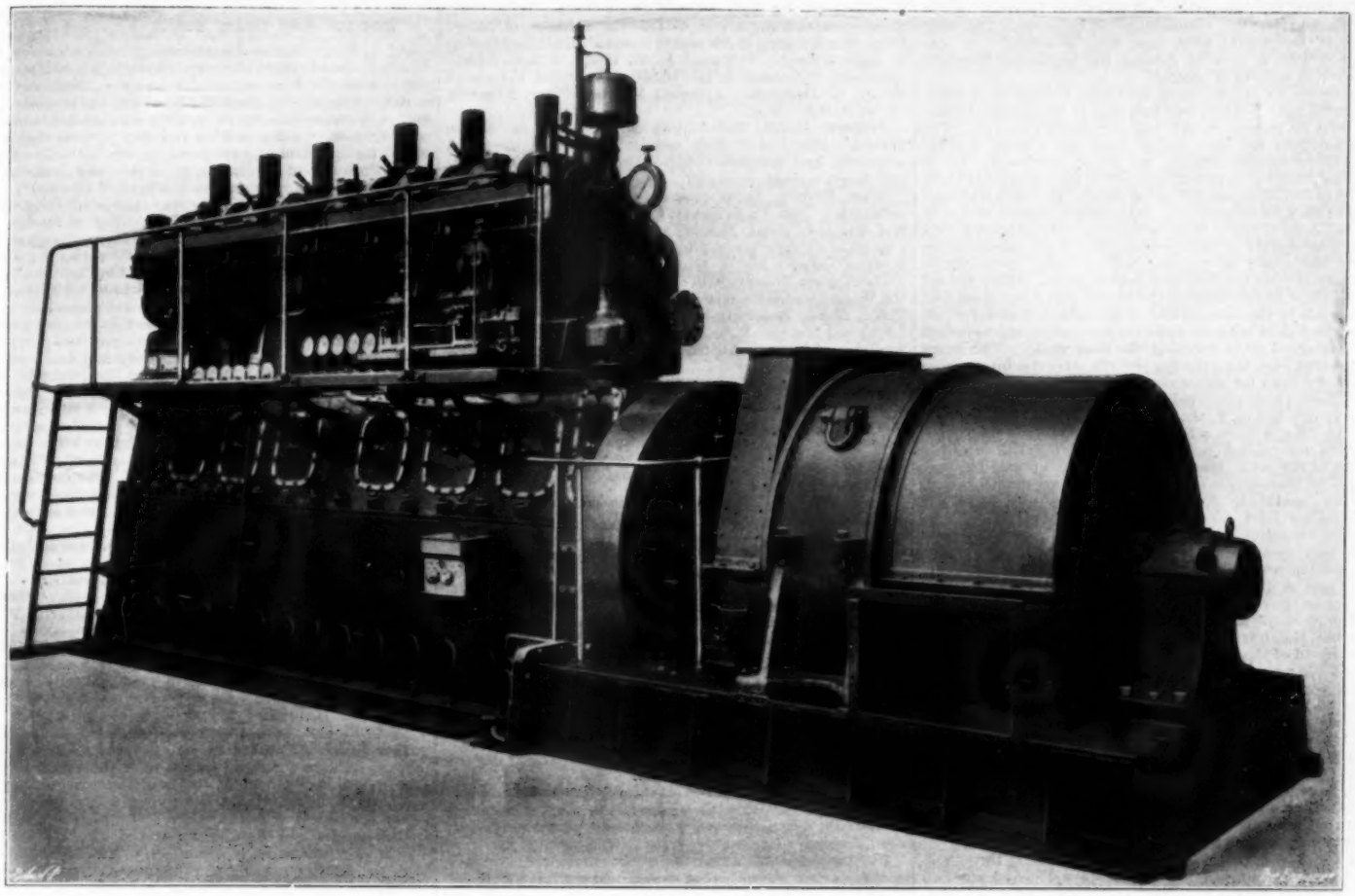
The President replied to the toast, and in extending a cordial welcome to the German Ambassador and Dr. Spengler, said that chemical engineers owe a great deal to German brains, foresight and work.

Replying to the toast of "Kindred Institutions," Mr. L. St. L. Pendred said he understood that young mechanical engineers were leaving their own ranks and going into chemical engineering because of the higher salaries offered. He feared that many were being tempted to go over to the chemical side without stopping long enough to complete their mechanical training, and he thought it would be better if their mechanical engineering training was finished off before they entered the chemical industry.

In responding to the toast of "Our Guests," proposed by Sir Arthur Duckham, who predicted that we are on the verge of a boom in industry in this

SIX-CYLINDER GENERATOR SET FOR H.M.S. RODNEY

W. H. ALLEN, SONS AND CO., LTD., BEDFORD, ENGINEERS



country, the German Ambassador spoke of the beet sugar industry and offered the assistance of German experts if they could forward the work being done in England. He also expressed the hope that the experts and scholars of both countries would co-operate to their mutual benefit.

A 300-kW Oil Engine Generator Set for Naval Service.

FOR some years past it has been standard Admiralty practice to include one or more oil engine generator sets as part of the lighting and power equipment of a battleship or cruiser. These units are of more than usual interest, since they have to be designed to give a comparatively large output with small space and weight. They must also work in parallel with the steam turbine-driven generators, and although often placed upon light foundations must, nevertheless, run entirely free from vibration at a high speed. In the following article we are privileged by the Board of Admiralty to publish some particulars of the two 300-kW, 450 B.H.P., six-cylinder generator sets which were designed jointly by Harland and Wolff, Ltd., and W. H. Allen, Sons and Co., Ltd., and were built by W. H. Allen, Sons and Co., Ltd., at Bedford, for H.M.S. "Rodney."

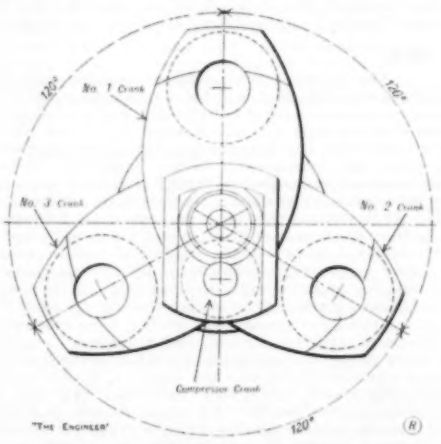


FIG. 1—CRANK ARRANGEMENT

The photograph reproduced above shows one of the engines and generators arranged for bench trials at the builder's works. In the "Rodney" there are two such units, placed in the port and starboard engine-rooms, which are arranged to work in parallel with the four steam turbine-driven generators, also supplied by Messrs. Allen. They are six-cylinder, trunk piston engines of the Allen-Burmeister and Wain four-stroke type, with a cylinder bore of 330 mm. (about 13in.) and a stroke of 450 mm. (about 17¾in). The designed output is 450 B.H.P. at 350 r.p.m. and the Allen dynamos have a rated output of 300 kW at that speed. The generators are of the two-bearing enclosed and pipe ventilated, shunt-wound type, and they are designed to be capable of running at the increased output of 355 kW for two hours, and at a 50 per cent. overload for two minutes. In order to facilitate parallel running with the turbo generators, each dynamo is furnished with two shunt regulators and one protecting coil. During the trials the guaranteed full load fuel consumption of 0·43 lb. per B.H.P. hour was easily obtained, and the sets when installed in the ship were found to be free from vibration at all speeds.

From the engraving above and the cross section through one of the main cylinders and the air compressor, it will be seen that a box type of bed-plate of a specially deep section, to allow the fly-wheel to clear the foundation, is employed. The bed-plate is furnished with transverse bearers, which are strongly ribbed to take the main crank shaft bearings and to accommodate the through-going tension bolts which take the working cylinder forces and secure rigidly the cylinder jackets, distance pieces, crank casing and bed-plate. There is bolted to the bed-plate an enclosed crank case, into the upper face of which the main cylinder liners enter. The crank case completely encloses the crank shaft and the running parts, and access to the journal bearings and the bottom end bearings is given by

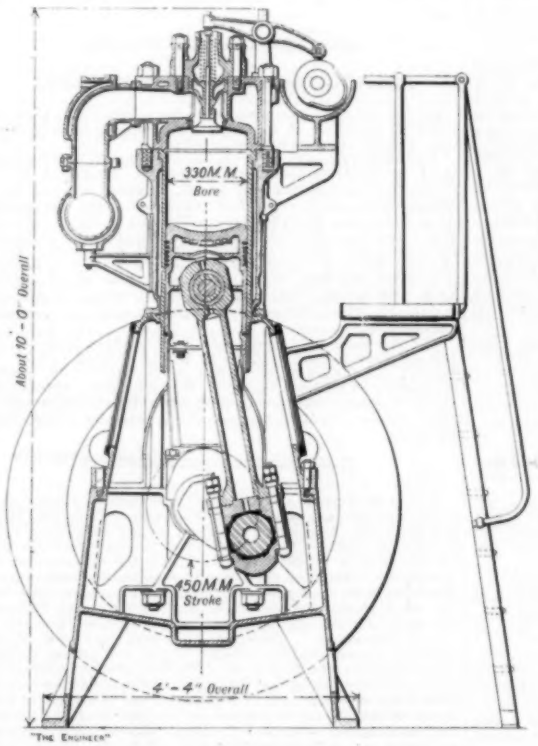


FIG. 2—SECTION THROUGH ENGINE

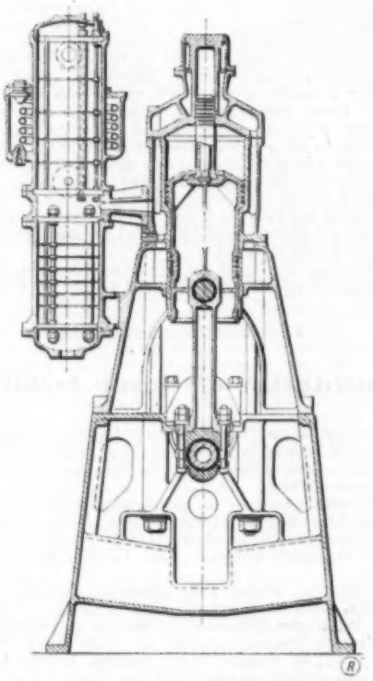


FIG. 3—SECTION THROUGH COMPRESSOR

six large aluminium inspection doors on either side of the crank case. The crank shaft is interesting in its design, since there are two sets of three cranks arranged at 120 deg. centres, as shown in Fig. 1, which is a view as seen from the compressor crank end. In order to reduce weight as far as possible, the cranks and journals are bored out. Steel tubes carry the lubricating oil from the journals to the bottom and top end connecting-rod bearings. The oval shape of the cranks webs may also be noted. It was adopted with a view of getting the maximum strength with the minimum of weight.

As shown by the sectional drawings, hollow connecting-rods with light bottom end bearings of manganese bronze are used to reduce weight and the inertia forces. The gudgeon pins are also hollow and are seated in solid manganese bronze brasses, to which lubricating oil is supplied from the centre oil passage in the connecting-rods.

The piston, although following closely the firm's standard design, may be referred to. It is deeply dished and is of the air-cooled type, with concentric strengthening ribs on the underside of the crown. The space immediately below the crown is enclosed with a light cover, which prevents any oil reaching the heated parts. There are six piston rings at the head of the piston and a lower scraper ring, while to the bottom end of the piston is attached an aluminium skirt with the object of preventing any splashed lubricating oil from reaching the liner walls. The liners are pressed into the cylinder jackets, and the intervening spaces are used for water cooling, suitable inspection and hand holes being provided.

As shown in Fig. 2, the joint between the cylinder head and the liner is made a little distance down the liner wall. Another interesting point in the combustion chamber design is the wide spacing of the air inlet and exhaust valves, so that valves of an unusually large diameter may be accommodated. Attached to each air inlet valve is a vertical air inlet pipe made of perforated steel. The exhaust manifolds are carefully water-jacketed and inspection doors which give access to the jacket spaces for cleaning are provided. The cam shaft is of the usual type, and is driven from a vertical shaft through spiral gearing on the crank shaft. The main governor is mounted on the vertical shaft, and there is also an emergency governor, the function of which is to cut out the fuel pumps if the speed of the engine should in any unforeseen manner exceed 400 r.p.m. There are two sets of three fuel pumps, which are arranged just above the platform at the fly-wheel end of the engine. This platform also gives access to the valve gear and the air and fuel starting controls, which are grouped at the centre of the engine. Immediately above the platform level at the compressor end of the engine there is a series of mechanically operated lubricators, controlling the supply of lubricating oil to the cylinder liners and the air compressor, while towards the centre of the engine a series of gauges for air and lubricating oil pressures is provided.

In Fig. 3, page 302, a cross section through the three-stage injection air compressor is shown. The compressor is driven direct from the main crank shaft from a special crank pin, shown in Fig. 1. The general design of the running parts, such as the connecting-rod and the gudgeon pin, follows closely that of similar parts for the main cylinders. The main body of the compressor piston carries the intermediate-pressure piston, and it is lengthened to give a large guiding surface; immediately above the piston referred to is the low-pressure piston, and on the top of it there is attached the self-aligning high-pressure piston. The jackets of the compressor are water-cooled, and an intercooler is provided for each stage of compression. The low-pressure and intermediate-pressure intercoolers are of the tube pattern, and the high-pressure after cooler takes the form of a copper coil enclosed in a spiral water-cooled casing.

Some interesting auxiliary units were specially designed to accompany the two engines we have described. They include water-cooled silencers and exhaust pipes, so that no undue heating of the engine-room spaces may occur in service. The cooling water is supplied by a separate motor-driven pump, which draws its supply through duplex strainers of the Royle type. For starting up, a small water pump fitted to the engine and driven by friction gear is employed. A separate motor-driven lubricating oil pump is used for starting up, after which the oil service is maintained by a directly operated pump of the gear type. For transferring the fuel oil to the ready-use tanks, a special motor-driven pump is fitted. The ready-use tanks are furnished with steam heating coils and an electric oil heater is also supplied for use with heavy oil, should this be required.

The total weight of the engine and generator we have described is only 31 tons, or about 154 lb. per B.H.P.

Institution of Naval Architects.

THE spring meetings of the Institution of Naval Architects will be held in the Lecture Hall of the Royal Society of Arts, John-street, Adelphi, W.C. 2, on March 28th, 29th, and 30th.

The annual dinner of the Institution will be held on Wednesday, March 28th, at 7.30 p.m., in the Grand Hall of the Connaught Rooms, Admiral of the Fleet the Right Hon. Lord Wester Wemyss, G.C.B., C.M.G., M.V.O., in the chair.

Wednesday, March 28th.—Morning meeting at eleven o'clock. Annual report of Council; election of President, Vice-Presidents, Officers and Council; presentation of the Institution Premiums to Mr. H. J. R. Biles, B.Sc., and Mr. W. C. S. Wigley, M.A.; address by the President, Admiral of the Fleet the Right Hon. Lord Wester Wemyss, G.C.B., C.M.G., M.V.O.; Sir John H. Biles, K.C.I.E., LL.D., D.Sc., Hon. Vice-President, "The Present Position of the Question of Fuel for Ships." Afternoon meeting at three o'clock. Mr. J. Foster King, Vice-President, "Bending and Loading of Ships."

Thursday, March 29th.—Morning meeting at eleven o'clock. Eng.-Capt. A. Turner, R.N., "A Note on Experimental Diesel Engines." Presentation of bust of the late Sir Philip Watts, K.C.B., LL.D., D.Sc., F.R.S., by the Right Hon. Winston Churchill, P.C., on behalf of the subscribers. Mr. E. H. Mitchell, Member, "Design and Propulsion of Fast Double-ended Screw Vessels." Afternoon meeting at three o'clock. Mr. E. Leslie Champness, M.Sc., Member, and Mr. Frank McAlister, Associate-Member, "Further Notes on the Relative Strength of Fine and Full Cargo Vessels;" Mr. William Sprague, Associate-Member, and the Staff of the William Froude Tank, "An Experimental Comparison of the Performance of Model Propellers Working in Air and in Water." Evening meeting at eight o'clock. Professor E. G. Coker, F.R.S., D.Sc., Associate, "Stresses in the Hulls of Stranded Vessels;" Mr. G. H. Hoffmann, Associate-Member, "The Effective 'I' of H.M.S. 'Wolf.'"

Friday, March 30th.—Morning meeting at eleven o'clock. Election of new members, associate-members, associates and students; appointment of scrutineers for the next annual meeting. Lt.-Col. V. C. Richmond, "Some Modern Developments in Rigid Airship Construction;" Mr. G. S. Baker, O.B.E., Member of Council, and Mr. J. L. Kent, Member, "Experiments on the Propulsion of a Single-screw Ship Model." Afternoon meeting at three o'clock. Mr. W. G. A. Perring, Associate-Member, "The Vortex Theory of Propellers and its Application to the Wake Conditions Existing Behind a Ship;" Mr. John Tutin, M.Sc., Associate-Member, "Cavitation;" Mr. J. Lockwood Taylor, M.Sc., Associate-Member, "Statistical Analysis of Voyage Abstracts."

COAL-FIRED CARGO VESSELS.

THE recent trials of the Canadian Pacific cargo steamer "Beaverhill" give some interesting information as to the advantages of coal-fired cargo steamers equipped with modern propelling machinery.

The "Beaverhill" is one of the five large cargo vessels which were ordered last year by the Canadian Pacific Railway Company for its services between London and Montreal, which is managed by Canadian Pacific Steamships, Ltd., of London. She was built by Barclay, Curle and Co., Ltd., at Glasgow, and is generally similar in design to the Denny-built ship "Beaverburn," which was described and illustrated in THE ENGINEER for January 13th. The only difference in the two ships is that whereas in the "Beaverburn" mechanical stoker-fired Yarrow type water-tube boilers are installed, in combination with hand-fired Scotch boilers, in the "Beaverhill" the main boilers are of the Babcock and Wilcox hand-fired superheater type. During the recent trials of the "Beaverhill" a consumption test of about ten hours' duration was made, during which the machinery developed approximately 7500 S.H.P. On this trial a coal consumption of 1·07 lb. per S.H.P. per hour for all purposes was, we are informed, recorded.

The fuel used was a mixture of Gartshore and Polmaise coal from Scottish collieries, with a heating value of 13,700 B.Th.U.'s per pound. The figures show the saving in fuel which is to be obtained by the use of geared steam turbines of the latest type in combination with the combined arrangement of coal-fired water-tube and Scotch boilers—suggested by Mr. J. Johnson, the owners' chief superintendent engineer—with a steam pressure of 250 lb. and a total steam temperature of 650 deg. Fah., we understand that in the ships fitted with mechanical stokers an even better boiler efficiency has been obtained. The trials referred to would seem to show that there is every possibility of getting, in actual service, down to a figure of 1·1 lb. of coal per S.H.P. hour, with ordinary bunker coal.

INSTITUTION OF CIVIL ENGINEERS.

AT the ordinary meeting on Tuesday, March 6th, 1928, the following elections of members and associate members and admissions of students were reported:—

As Members (3).—F. W. A. Handman, Arapuni, New Zealand; R. H. Horsfield, Melbourne; G. Nelson, Hawkes Bay, N.Z.

As Associate Members (16).—J. W. Allison, Glasgow; D. S. Bulbin, B.Sc., Perth; R. MacP. Campbell, B.Sc., Skelmorlie; J. A. L. Denison, B.A., Henley-on-Thames; A. W. J. Dymond, B.Sc., Swindon,; R. G. Edkins, B.A., Shanghai; H. H. Facey, Bournemouth; L. W. H. Hall, B.Sc., Buenos Aires; M. B. Hember, Taunton; S. H. W. Middleton, B.A., B.A.I., Belfast; C. S. P. Randel, B.A., B.A.I., Singapore; J. H. Shennan, B.A., Leith; H. Whipp, B.Sc., Oldham; R. G. Wilson, Singapore; L. G. H. Wynn-Williams, B.Sc., Darlington; D. Yorke, Hereford.

For Admission as Students (12), *February 21st*, 1928.—R. W. Daniel, Southampton; M. F. E. Dobbin, Dublin; V. A. C. Durand, B.Sc., Cardiff; P. E. Haines, Devizes; J. W. Hunter, Highgate; P. H. Jones, Enfield; W. Latto, B.Sc., Clydebank; W. K. Marples, Swindon; G. E. Roberts, B.Sc., Cardiff; M. T. Shaw, Belfast; T. McG. Simpson, B.Sc., Scotstoun; J. S. Watt, Inverurie.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—The sixteenth annual dinner of the Finsbury Technical College Old Students' Association was held at the Engineers' Club, London, on Friday, March 2nd, when the chair was occupied by Mr. Francis H. Carr, C.B.E., F.I.C., the President of the Association. About seventy members and friends were present. The loyal toast having been honoured, the President expressed the great pleasure it was in having his old friend Professor Henry E. Armstrong, F.R.S., present to propose the toast of "The Association." Professor Armstrong said that at the Finsbury College, which Professor Ayrton and he had started, to carry out the scheme of the City Guilds of London Institute the curriculum was arranged at the beginning to provide the chemist with some understanding of engineering and the engineer with some understanding of chemistry. He had no place for the chemical-engineer as produced to-day. He was neither chemist nor engineer; engineering should be left to the engineer. He felt sure that in years to come the founders of Finsbury would regret the abandonment of Finsbury and of the Finsbury policy at the Central. Finsbury decided at its outset never to touch Science and Art Department or other external examinations, whereas now everywhere examinations are the order of the day. Teachers are bound by fixed curricula, and no teacher is free to teach what he thinks best; he has to teach what he is told. Dr. W. H. Eccles, F.R.S., replying on behalf of the guests, ladies as well as gentlemen, put forward the suggestion that someone should write a "History of Finsbury" whilst so many were still here who would give particulars of the early days of the great institution.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

Iron and Steel Trades' Straits.

MANY Midland industrialists this week say that Mr. A. E. Bond voiced their sentiments when at the annual meeting of the Birmingham Exchange on Saturday last, in discussing general trade conditions in the iron and steel and coal industries, he advocated a reasonable measure of protection to safeguard the industry against the dumping of foreign steel at uneconomic prices. Mr. Bond, who is the President of the Exchange, maintained that it would help them to compete in the markets of the world. He asserted that so long as there was no restrictive duty on imports into this country, the quantities of foreign iron and steel sent here were likely to increase. A comparison of trade conditions during the past year with the previous year was not helpful, because of the long and disastrous stoppage of the coal mines during 1926. Perhaps the most disturbing point revealed by an examination of the trade statistics for the last year was that we had actually imported more iron and steel than we had exported. During last year we had not entirely supplied our own needs; we had, in fact, bought from the foreigner while we had both plant and workers standing idle. He asked what was the remedy for this position, and answered a measure of safeguarding. Most of our British steel plants, he pointed out, were remodelled during or after the war, and the best British steel practice to-day compared favourably with that in any part of the world. What was needed was an outlet that would enable our own steel works to run full time, and to a considerable extent this outlet could be found at home by stopping the supplies of foreign material that were at present coming in here in millions of tons. It might interest the meeting to hear, he continued, how the production of steel in Great Britain and other countries had increased since 1913. France's 6,864,000 tons in 1913 had increased in 1927 by 17 per cent. to 8,070,000 tons. Germany's 12,000,000 tons by 33⅓ per cent. to 16,051,000 tons; U.S.A.'s, 31,301,000 tons by 41 per cent. to 44,400,000 tons. Belgium's 2,428,000 tons by 51 per cent. to 3,656,000 tons; Luxemburg's 1,308,000 tons by 85 per cent. to 2,432,000 tons; and Great Britain's 7,773,200 tons by 18 per cent. to 9,098,000 tons. This small percentage increase in British output during the past fourteen years was not satisfactory, and it compared unfavourably with the increases that had been obtained both on the Continent and in America. He believed, however, that if the British steel makers were given a reasonable measure of protection the output of British steel would show a large and satisfactory increase. The past year had been one of exceptional difficulty for the coal industry, and the present outlook was not encouraging. Like the steel trade, collieries were suffering from lack of demand, but in the case of coal it was in the exports markets that we had lost trade so heavily. Very great sacrifices had been and were being made to increase the export business, and some little improvement had already taken place; but a great deal more remained to be done before we could recover our large pre-war export coal trade. "Here, again, to some extent," said the speaker, "a remedy would seem to be the safeguarding of the iron and steel trades, which would result in a largely increased home demand for coal and coke, and would provide work for more men, both in the collieries and in the ironworks, and generally would produce a more prosperous time for our basic industries."

Birmingham Exchange.

The forty-eighth annual report of the Birmingham Exchange presented at the annual general meeting last week disclosed a sound and healthy condition. The receipts from all sources at £7822 showed an increase of £106, expenditure (apart from investments) at £5661, a decrease of £289, and the surplus on the year's working at £2160, showed an increase of £395. There was unfortunately a small decrease in the amount of subscriptions. The balance carried forward was £1909 17s. 9d. On the proposition of the President, Mr. A. E. Bond, seconded by Mr. H. Bertram Hingley (vice-President), the report was adopted.

Steel.

The improvement in the steel trade is gradually though slowly extending, and there are prospects of considerably increased sales of both finished and semi-finished material in the near future. Midland mills have better order books than has been the case so far this year, and the mills are consequently better employed. Orders from constructional engineers, though still small individually, show a better aggregate as do those from rolling stock firms. Some good contracts have been given out for rolling stock, from which several Birmingham works will benefit, and a larger demand will be made upon Midland mills. The motor engineering industry is, as its season approaches, increasing its consumption of finished steel. It is stated to be absorbing the output of high quality material. A month or two ago Germany was sending large quantities of this steel into Birmingham, and the Black Country, but fewer orders are now going abroad, and there is less foreign material coming into the district. Higher prices and lagging delivery are having their effect upon sales of continental steel. Two to three months is now generally named as the earliest possible date for delivery. British billet makers have in some instances improved their competitive power by reducing their prices. The price of £5 15s. for foreign billets is now accepted by a Welsh firm, though other makers want £5 17s. 6d. to £6 for their output. Many thousands of tons of billets have recently been sold to re-rollers, especially makers of sheets and tinplate. Midland merchants who have for years specialised on foreign semi-finished steel, have, it is understood, bought many tons of these billets for disposal to local mills. Foreign bars at £6 10s. find few purchasers. Native finished steel quotations are as last week.

Raw Iron

There is little change in the situation in the raw iron industry on the week. Demand has not further in-

creased though by now the usual spring movement in the building trade should have had its effect upon the foundry industry. The foundries, however, are poorly off for orders, and engineering, which generally provides a large amount of work for local foundries, is lacking in its support. There are a few Midland blast-furnaces with good order books, but others find a portion of their present low output going into stock. It is asserted that something less than the recognised level of prices would be accepted by these blast-furnacemen for good tonnages. Evidence of this is, however, lacking, and on 'Change in Birmingham this week Derbyshire makers continued to quote foundry at £3 4s. and forge at £2 19s. Northamptonshire brands were likewise firmly quoted, £3 being the price named for foundry and £2 14s. for forge grades. Buyers continue to act cautiously, some being inclined to the opinion that values will deteriorate. Smelters maintain that lower prices would entail unprofitable production.

Finished Iron.

The Staffordshire finished ironworks are fairly busy, chiefly on marked bars and tube strip, though rather large tonnages of steel are being re-rolled. There is a fairly good demand for chain and anchor iron, but the nut and bolt trade is taking very little native material. Rolling stock firms are consuming good tonnages of best iron. Marked bars continue at £12 10s. per ton, while the minimum for Crown quality iron has receded to £9 5s. Staffordshire firms will not accept less than £10, and some firms ask as much as £10 10s. Lancashire houses still compete keenly for all the business which comes on to the market. Nut and bolt and fencing bars are quoted at £9, but there are few buyers, most of the available orders continuing to go to continental competitors. Wrought iron gas tube strip makes £11 10s.

Galvanised Sheets.

Demand for galvanised sheets remains excellent, orders for sheets coming from world-wide markets. India, in particular, is at the moment buying freely. Quotations for 24-gauge corrugated sheets are generally maintained at £13 10s. for both home and foreign consumption. While it is possible to get a concession of 2s. 6d. for a good order, there are cases where the £13 10s. standard is exceeded. Black sheets are selling better at recent rates.

Scrap.

Scrap sales are improving, and, although this material is commonly sold at £3 delivered in South Wales, the merchants ask an additional 2s. 6d., and believe they will get it shortly.

Trade Returns.

Industrialists hereabouts express pleasure and satisfaction that the Board of Trade Returns of Imports and Exports during the month of February show an improvement in the country's trading position. They are particularly pleased to note the advance over the corresponding month last year in exports of articles wholly or mainly manufactured. Sixteen out of the twenty classifications under this heading showed an upward trend, the largest increases being: Cotton yarns and manufactures, £934,851; other textile materials, £511,611; vehicles, including locomotives, ships and aircraft, £506,861; machinery, £448,676; iron and steel and manufactures thereof £390,386. The export of coal was still down last month, showing a decline on February, 1927, of £830,409. The decline in imports of iron and steel also gives cause for gratification. The total quantity of iron and steel imported during the month was 286,918 tons, valued at £2,259,024, compared with 443,424 tons, and £3,383,452 in the corresponding month of last year. For the year to date the quantity imported was 570,839 tons, valued at £4,556,944, compared with 998,877 tons, and £7,696,061 in the preceding year.

Birmingham Brass Trade.

A steady improvement is taking place in the Birmingham brass trades. Both in the ships' fittings and electrical branches the works are particularly busy, while the resumption of activity in the building trades is expected to improve the outlook as regards plumbers' and similar fittings. Generally speaking, both foundries and stamping shops are busier than they were a month or so ago.

Warwickshire Colliery to Close.

The plight of the coal industry in Warwickshire, in common with other parts of the country, is emphasised this week by the announcement that on economic grounds, George Skey and Co., Ltd., of Wilnecote, have decided to close their Tame Valley pit. About 450 men will be affected by the closure of the mines. This, I regret to record, is not all, for 100 miners employed at Stockingford Colliery, Nuneaton, have also received notice owing to the trade depression.

Position in the Notts. Coalfield.

The Nottingham coalowners on Saturday last decided in response to representations made to them by the General Council of the Trades' Union Congress and the Executive of the National Miners' Federation to attend a joint conference in order that the situation in the Notts. coalfield may be discussed. The principal question to be raised at the joint conference will be the owners' alleged non-recognition of the Notts.' Miners' Association, which states that the owners gave preference in employment to members of the non-political union headed by Mr. G. Spencer, M.P.

Unemployment.

A considerable decrease in the number of unemployed in the Midlands has occurred during the past week, the latest returns showing them to number 134,738, or 4326 fewer than they were when the statistics were last compiled. The decline in the figures is fairly general throughout the area, the only places where unemployment has increased during the week being Derby, Leicester, Redditch, Worcester, and Stourbridge and Brierley Hill. The total for Birmingham now stands at 26,272. In the Midlands there are now out of work 102,363 men, 26,216 women, 3036 boys and 3123 girls.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Cable Contract Goes to Holland.

As it has done on several occasions during the past year or two, the Salford City Council, on the recommendation of the Electricity Committee, has decided by 23 votes to 12 to place a contract for the supply of electric cable with a Dutch company, the successful firm being the N.V. Nederlandsche Kabelfabriek, of Delft, and the contract price £8080. In the course of the discussion, it was revealed that lower tenders than this one had been received from abroad. In one case, that of a German concern, samples of the firm's cable had been examined by the city electrical engineer, but they had not proved satisfactory. Alderman Billington, the chairman of the Electricity Committee, who moved the acceptance of the Dutch tender, said that among the British offers was one from a firm not far from Salford which, however, had only been engaged in cable making for about two years, whilst the work required years of research and experience before a town could risk placing an order like the one under discussion, though small orders had been given to the firm in question for test purposes. Of two British tenders that were referred to, one was for £9530 and the other for £8558. 'An amendment that the latter be accepted received inadequate support.

Belt-makers' Association.

Alderman H. A. Cole, of Henry A. Cole and Co., Ltd., Liverpool and Birkenhead, was elected chairman, and Mr. C. A. Dimoline, of the Gandy Belt Manufacturing Company, Ltd., of Seacombe, Cheshire, vice-chairman, for the current year at the annual meeting of the British Association of Balata Belt Manufacturers, held in Manchester.

Presentation.

Captain and Mrs. R. S. Hilton, at a dinner here on Monday evening, received a valuable presentation which had been subscribed for by the directors and staff and over 5000 operative employees of the Metropolitan-Vickers Electrical Company, Ltd., of Trafford Park, Manchester. Captain Hilton has resigned the managing directorship of the firm after nine years' service to accept a similar position with the United Steel Company, Ltd., Sheffield.

Obituary.

The death has occurred this week, at the age of eighty-nine years, of Colonel Ralph Peacock, son of the late Mr. Richard Peacock, who over seventy years ago established the Gorton Foundry, Manchester, which afterwards developed into the famous locomotive building and engineering firm of Beyer, Peacock and Co., Ltd. Colonel Peacock gained his early engineering training in the shops at the Gorton Foundry, and in order to widen his experience was sent to work with the French firm of Ernest Gouin and Co. After several years there, during which he was employed in the designing of bridges, dredging machinery and lighthouses, he returned to the Gorton Foundry, and eventually, in 1889, he succeeded his father as managing director. Upon the conversion of the concern to its present basis as a public company in 1902, he accepted a seat on the board of Beyer, Peacock and Co., and continued to serve in that capacity until his retirement from business activities several years later. Colonel Peacock was a member of the Institution of Civil Engineers, the Institution of Mechanical Engineers, and the Iron and Steel Institute. I have also to record the death, which occurred on Sunday, 11th inst., of Mr. Frederick Walthew, at his home at Stretford, in his seventy-first year. Mr. Walthew was well known in engineering circles in the Manchester district on account of his former association with Galloways, Ltd., and his long connection with the Manchester Association of Engineers, of which he was for many years honorary secretary. Since he retired, Mr. Walthew devoted his time largely to public, philanthropic and religious affairs.

Non-ferrous Metals.

The most striking feature of the non-ferrous metals market during the past week has been the renewed weakness in the tin section. The forecasts, on the strength of the relative steadiness of the metal during the previous two or three weeks, of a possible period of steady prices have not been borne out, the loss on balance at the time of writing being over £7 a ton. A fair amount of tin has changed hands, and warehouse stocks in this country have latterly been showing a declining tendency. The statistical position, however, is far from strong, and the market has been unable to withstand the "bearish" influence of heavy shipments from producing countries during the past two months. In the copper section, the demand from consumers has been rather more active, and a further slight gain in prices has taken place, current quotations for standard brands being about back to where they were three weeks ago. In spite of a relatively poor inquiry from consumers of spelter, values are only fractionally easier than they were a week ago. Lead is slightly weaker on balance, and the demand in this section of the market shows few features of interest, supplies of the metal being quite adequate.

Iron.

If the outlook in the Lancashire market for foundry pig iron is rather less depressing than of late, it is more a question of a slight improvement in prospects than of any expansion of actual business done during the past week. On the whole, conditions at the consuming end are not too hopeful at the moment, although in the fortunate instances where the state of the order books warrant it, there has been no hesitation on the part of users, particularly at to-day's prices, to cover themselves adequately for future supplies. One or two such cases have been reported this week where contracts for fairly large quantities, chiefly renewals, have been placed. The possibility of Midland producers of the metal following the lead of those of the North-East Coast in stiffening quotations may, in the course of the next week or two, result in a slight spurt in the general demand. Staffordshire makers are quoting No. 3 iron for delivery in this district at 71s. 6d. per ton, with Derbyshire varying from 62s. to 72s. 6d., according to quantity. The increase of 1s. a ton in the furnace price of Middlesbrough iron brings the delivered quotation here to 79s. Scottish makes are steady and remain unchanged at from 86s. to 87s. 6d., while hematite iron is still quoted here at about 84s. per ton, including delivery in each case. Bar iron is maintained at £10 per ton delivered for Lancashire Crown quality, and £9 10s. for seconds, but the demand in this section of the market shows no improvement.

Steel.

There is still a quietly steady call from Lancashire constructional engineering firms for manufactured steel, but the demand from most other branches of the steel-consuming industries in this area is on strictly modest lines. With the exception of a stronger tendency in the case of small steel bars re-rolled from imported semi-finished products, there has been practically no change in the price situation. Last week re-rollers were prepared to accept down to £7 10s. per ton for small bars, but offers on this basis have now been entirely withdrawn, and £7 12s. 6d. is being currently quoted. Large bars remain at £8 17s. 6d. per ton, with joists and sections at £7 17s. 6d. and ship and tank plates at £8 12s. 6d. Boiler plates, which are in moderate demand from locomotive builders, keep fairly steady at £10 per ton for acid plates, basic varieties being obtainable at about 5s. below this figure. On the whole, quotations for continental steel products keep firm all round, although there has been no further advance on recent rates. For delivery to Lancashire users' works, for net cash against shipping documents, imported wire rods are being offered by continental makers at £6 12s. 6d. per ton, billets at £5 7s. 6d., sheet bars at £5 12s. 6d. to £5 15s., Siemens plates at £7 15s., joists and sections at £5 17s. 6d., and steel bars at about £6 10s. per ton.

Manchester Association of Engineers.

At a meeting of the Manchester Association of Engineers, held on Friday, March 9th, Mr. N. Greenhalgh, A.M. Inst. Mech. E., read a paper, entitled "Examples of Modern Tool Room Practice." Mr. Greenhalgh is on the staff of Hans Renold, Ltd., whose tool-room finds employment for 130 persons, divided into the following sections:—Turning, milling, surface grinding, cylindrical grinding, fitting and gauge making, repair and inspection, and the products of this department range from special machines, such as punch presses weighing several tons down to small gauges and tools. Attached to the tool-room is the pattern shop, so that, except for making the castings, machines are finished completely in the tool department. One of the advantages of this arrangement is that the patterns can be viewed from the machining standpoint and any locating faces or clamping lugs which are likely to save time when machining may be added before sending the pattern to the foundry. The paper was confined chiefly to descriptions and details of blanking, holing and shaving, dies and punches used in the manufacture of chain links, forming and backing-off tools, single-thread tools for screw gauges and hardened flat gauges. The machines for producing these articles in large quantities were also fully described. The paper was illustrated by a large number of lantern slides

Institution of Mechanical Engineers.

At a meeting of the Graduates' Section of the North-Western Branch of the Institution of Mechanical Engineers, held at the Engineers' Club on Thursday, March 8th, a paper on "Locomotive Running Repairs" was read by Mr. John Blundell (associate). The paper was thoroughly practical, being based on the author's own personal experiences in this branch of railway operations. He said the repairs dealt with the running shed are limited to adjustments, replacements and examinations necessary to obtain a reasonable life from the engine between general overhauls in the heavy repair shops which formed part of the mechanical engineer's department. Engines ran from 30,000 to upwards of 100,000 miles between general overhauls, and the length of time in service varied between fifteen and forty months, according to the nature of the work, passenger or goods, fast or slow, the size of wheels, and local conditions, such as the quality of the water used, gradients, and curves. The author presented an instructive diagram showing how the coal consumption of a locomotive increased with wear, slightly at first, but very rapidly as the time for a general overhaul approaches. The seasonal variation in the coal consumption was shown to be very marked, being the highest in February and lowest in August. After a "valves and piston" examination, the coal consumption fell by from 3 lb. to 8 lb. per mile. Most of the work had to be done in the running sheds "against time," as the number of engines generally allotted to a depôt did not permit of many engines being laid up for repairs simultaneously. Even under these conditions the mileage run per failure, which included even small periods of time lost owing to engine defects, was in the neighbourhood of 121,500 for passenger engines and 47,500 for goods locomotives. Only in a very small number of these failures was an engine actually disabled and unable to complete its booked working.

BARROW-IN-FURNESS.

Hematite.

There is unfortunately no sign of improvement in the hematite pig iron trade in this district; in fact, if

anything, the trade is worse. It is difficult to understand the position in view of a certain activity amongst founders, engineers, &c. Those works which are idle still have stocks, and these stocks are not being reduced at anything like a desirable rate. Other works which are producing are also forced to put into stock, and this is particularly applicable to Cumberland, where the steel trade is not so good as it was. A broker the other day voiced a regret that the old system of warrants no longer obtained. Under the warrants system, he said, production was steady, and when stocks accumulated, there were not the same fluctuations, and iron makers were less the victims of ups and downs. Of course, this was a one-sided opinion, and there are many objections which could be advanced against the argument, but certainly there are many who agree with this view. The iron ore trade, in view of the small number of furnaces in blast in the district and of the small amount which is being exported, is only moderately busy. Imports of foreign ore are similarly affected. The steel trade in Barrow is quite and fresh orders are urgently needed to keep the rail mills engaged. It looks as if there would be an extended holiday period at Easter, judging from present signs. The hoop mills are well engaged, and likely to remain so. There have been certain stoppages in the steel departments at Workington, consequent upon lack of orders.

Engineering.

The International Combustion Company, in view of centralisation at Derby, is closing down its branch works at Barrow, which adjoin the Vickers-Armstrong's Naval Construction Works. This stoppage, which has been anticipated for some time, will affect about 400 hands, but it is expected that a number of them will be transferred to Derby. The release of this section of the Construction Works, which during the war was used for the production of shells, &c., will leave the department available for Vickers-Armstrong's development.

SHEFFIELD.

(From our own Correspondent.)

Situation in the Steel Trade.

It is rather curious that, with continental prices of steel rising and thereby causing an increase in the demand for local products, the condition of the Sheffield steel industries generally shows a decline rather than an improvement. At most of the steel works and mills, whether heavy or light, it is reported that bookings have fallen off, and also that inquiries are less numerous than they were earlier in the year. While there are many orders, a great proportion of them are small in quantity, and bulk requirements are scarce. It may be that the decline is only a temporary fluctuation, but, as this is a period of the year when increase of business is expected, the situation is disappointing. The departments catering for electrical engineering continue busy. The automobile makers are still calling for a large amount of Sheffield steel and tools, and are providing valuable work for a number of firms, but although the requirements of the lorry and omnibus section of the trade are on a good scale, the demand in respect of touring cars is below the average.

Some Busy Firms.

During the past month—since the prices of continental material began to rise—importations of pig iron and manufactured iron and steel at the East Coast ports have shown a reduction of nearly 50 per cent. How long the present level of foreign prices will be maintained cannot, of course, be foreseen, but at the moment it is benefiting local trade. At any rate, a proportion of the business which has been going abroad is now being placed with works in this country, including Sheffield. The heavy steel department is gaining an advantage, and it is stated that Steel, Peech and Tozer, Ltd., have received more orders for basic billets during the last few weeks than at any time for several years. They started the year at their Templeborough works with only six open-hearth furnaces working, but last week two more were gassed. The big melting and rolling plants at the Parkgate Iron and Steel Works have been running since the New Year almost up to full capacity. The firm of Vickers is very busy. At the River Don Works the firm has now a wider range of products than ever before, many peace lines having been introduced to make up for the falling off in armament work. Regular employment is now being found for more than 7000 people. It is understood that, following the recent fusion with Armstrong-Whitworths, certain manufactures from the latter firm's works at Manchester will shortly be transferred to the River Don Works, and the construction of military tanks will be retained in Sheffield. In contrast to the activities of these firms, there are to be set several instances of works losing ground. Last week a Siemens steel plant and a wire rod mill in Sheffield were set down indefinitely. There is only a moderate demand for wire and wire ropes.

A Subsidy on Armaments.

The question of the payment of a Government subsidy to armament firms, to encourage them to maintain full plant and equipment in excess of actual requirements, has often been raised, but so far as I am aware little information has been available with regard to it. There is, however, an interesting reference to the matter in the report of the Comptroller and Auditor-General on the Navy Appropriation Account for the last financial year. He shows that a few years ago the Admiralty, "while prepared to contribute to the maintenance of that proportion of the plant which they would require for the maximum needs under their shipbuilding programme, preferred that such contribution should take the form of an addition to the normal price of armour actually ordered, *i.e.*, to fix prices which would have regard to the total output and would cover dead charges on plant not fully used, but kept in being." On this basis prices were fixed for the year ending October 31st, 1926, including an element of contribution which, though above the Admiralty's original offer, was much further below the amount suggested by the firms. A similar agreement has been effected for the following year. The element of contribution will vary each year inversely with the quantities of armour actually ordered, and in the two years for which prices have been fixed will amount to an average of approximately £90,000 a year. This figure will, however, be reduced to the extent that the firm's plant is engaged on private or additional Admiralty orders in the period, as the firms are to allow the Admiralty a rebate for each ton of armour so ordered. The Comptroller remarks that the principle underlying these arrangements, as applied to industrial firms, represents a development of so unusual a character that he has thought it desirable to refer to the matter.

A Safeguarding Suggestion.

Increasing interest is being taken in the question of the safeguarding of the iron and steel industries, and there is a growing call for such assistance. This call was strongly supported at the annual meeting of the Sheffield branch of the National Union of Manufacturers, where attention was called to the increase of foreign competition in manufactured articles as well as raw materials. Mr. A. J. Capron, of the well-known engineering firm of Davy Brothers, Ltd., put forward a definite suggestion with regard to the amount of safeguarding that is desirable. He urged that a flat duty should be placed on foreign iron and steel, such as 5s. to 10s. a ton on pig iron, 15s. to £1 on ingots and slabs, and 30s. to £2 on rolled materials. A duty such as that, he said, could be got through quickly, but if they tried to provide for every separate trade it would take a long time.

Railway and Tramway Work.

The London and North-Eastern Railway Company, which is obtaining twenty Sentinel-Cammell steam rail coaches for use in its North-Eastern area, has placed the first four of the vehicles on a series of new services in the Hull district. It has also ordered twenty more of these coaches from the Sentinel-Cammell Company. Doncaster is considerably interested in the announcement that the same railway company is to construct at its locomotive works in that town mammoth locomotives which have been specially designed for a record-breaking non-stop run of 395 miles from London to Edinburgh. The engines will be connected by means of a narrow passage through the tender and a flexible covered gangway with the rest of the train. Members of the National Association of Clayworks Managers from various parts of the country last week paid a visit to the works of S. Osborn and Co., Ltd., Sheffield. Among other things seen were castings awaiting transit for tramways in Manchester, Liverpool, Oporto, Amsterdam, and other places.

Artificial Silk Factories.

It is announced that a large factory is to be erected on the Colwick estate, just outside Nottingham, for the manufacture of artificial silk for the lace, hosiery, and textile trades of Nottingham, Leicester and the Midlands. Twenty-one acres of the estate have been purchased for the purpose. The new mill will be one of the best in Britain, and will employ between 2500 and 3000 workers. It will be the fifteenth of any size to be built in this country, where three years ago there was only one. It is also reported that the George-street Mill, Brighouse, which was formerly used for cotton spinning, but has been empty for some time, is about to be reopened for the manufacture of artificial silk fabrics. A company to be called the Yorkshire Artificial Silk Company is to be established, and is to commence operations in a few weeks. The employees are expected to number from 800 to 1000.

Drainage Works near Doncaster.

If the suggestions of the engineers to the Doncaster Drainage Commission are carried out, wholly or in part, there will be a great deal of civil engineering work to be done in that district in the course of the next few years. The Commission has now issued its report, in which the opinion is expressed that numerous works appear to be desirable for the improvement of the existing drainage channels in the area, but a decision regarding their execution is postponed until they have received the consideration of the new Drainage Court that is to be set up. The report, however, includes numerous suggestions by the engineers for costly works in the raising of river banks and bridges. One scheme is for enlarging the channel of the Don at an estimated cost of £250,000; another, the construction of a catchwater drain between Haxey and Westgate, at a cost of £20,000; and there are many more suggestions. The duty of remedying subsidence due to colliery workings is to be left to the colliery companies themselves, the Drainage Court having power of supervision and default.

Matters Electrical.

Chesterfield is to cease generating its own electricity and to purchase its supplies in bulk. At present a small portion of the current used is received from the Staveley Coal and Iron Company, but this is to be given up in February next year. It has been decided to take a bulk supply from the Notts. and Derbyshire Power Company for five years. The Corporation is seeking powers to borrow £16,250 for the provision of a sub-station, with plant, cable, &c. The chairman of the Electricity Committee told the Town Council last week that this meant that in five years the Chesterfield Corporation would cease to generate electricity. He said that last winter the Committee was not at all happy, because the demand was such that had apything gone wrong when the peak load was on someone would have had to go short. In order to make the position secure for next winter, it would have been imperative to put down additional plant or arrange for an increased bulk supply. When the Commissioners were approached, they turned down proposals that the town should be permitted to put down a 5000-kilowatt set at a cost of £50,000 or a second-hand set at one-half that amount. The Commissioners said, in effect, that the Corporation might be allowed to spend the money, but in five years at the outside the Commissioners would be able to offer current at a less price than it could be generated at in Chesterfield, and that they could compel the Corporation to take supplies from them, and also compel them to shoulder the cost of the capital outlay. The Commissioners also turned down a suggestion of taking current from the Staveley Company, but they looked with great favour on the proposal to take a supply from the Notts. and Derbyshire Power Company, which fitted in with the national scheme. The chairman added that he had no pleasure in saying that eventually the Chesterfield generating station would close down. While the national scheme would be a godsend to places where the price was high, he could not see any tumbling down of price at Chesterfield, where the charge was 4d. net per unit. The Corporation electricity works showed a record profit for the present year, and the Committee would grant the maximum amount allowed by law for the relief of rates. The progress of electricity at Derby is shown by a remark of Alderman W. G. Wilkins, at last week's Council meeting, that the output was now 32,000,000 units per annum, but in four years' time it was estimated that they would require an output of 48,000,000 units. He added that after allowing £78,000 for depreciation of plant, interest and sinking fund charges, they expected a profit of from £25,000 to £30,000 this year.

Doncaster Schemes.

Doncaster Town Council has resolved to apply to the Electricity Commissioners for sanction to borrow £44,700 for renewals and other electricity works during the next two years. It has received the sanction of the Ministry of Transport for the borrowing of £12,600 for the purchase of ten single-deck motor omnibuses. The work of road construction on the Woodfield-road housing site has been given to Swift Bros. and Haslam, Ltd., whose tender amounted to £8389.

NORTH OF ENGLAND.

(From our own Correspondent.)

Trouble in Northern Coalfields.

Communist agitators have been busy in the Durham and Northumberland coalfields urging the men to resist the recent awards of the Independent Chairmen. At several collieries the putters struck work in the latter part of last week, but most of them have now returned, and their resistance has, to all intents and purposes, collapsed. Drastic action, however, has been taken by Horden Collieries, Ltd., in respect of the Horden Colliery, at which it is alleged that organised restriction is being practised by a number of the workmen, which is stated to be the outcome of Communistic propaganda. Over 400 men employed at the colliery have received fourteen days' notice to terminate their employment, and in justification of this course, the firm points out in a circular to the men that the colliery is now drawing between 2000 tons and 3000 tons per day less than normally, and that the output, which is normally 6000 tons per day, was last week actually down to 2000 tons per day. It is stated that the restriction is being practised by the putters, and that the coal hewers are neither restricting nor acquiescing in the restriction. The 400 men on notice are stone men, screen men, and mechanics, and they are being dispensed with because of the considerably reduced quantity of coal to be handled. The circular further points out that: "A statement has been circulated that last year the Horden Collieries, Ltd., paid a dividend of 10 per cent. This is entirely untrue. As a matter of fact, no dividend at all was paid in 1926, and only 2½ per cent. in 1927, which is only equivalent to an average of 1¼ per cent. per annum, and even from this amount, 4s. in the £, or one-fifth, was deducted and paid to the income tax collector, leaving only 1 per cent. per annum actually paid to the shareholders for the two years in question. At the present moment the pits are working at a loss, and have been for some time." It is hoped that the circular issued by the firm will have the effect of leading to a cessation of the restriction which it is stated is being practised.

Iron Prices Advanced.

The optimistic tone that has characterised the Cleveland pig iron trade since the beginning of the year still prevails, and an advance of 1s. per ton in prices this week occasioned no surprise. For some weeks a rise had been anticipated, makers consistently making it clear that previous quotations, which had remained unchanged since November 24th last, were unremunerative. Smaller continental competition, due to overseas firms being well sold and the consequent advance in foreign commodities to levels which enable producers here to invade once more markets that have been lost to the district for some time, is a factor which has strengthened the Cleveland market. Sales of Cleveland iron have, in fact, been so substantial that the present output is already practically earmarked for the next two months, and forward contracts have been made for delivery as far ahead as September. Buying of continental iron for consumption in this district has virtually ceased, but imports in fulfilment of old contracts are still coming forward. The producers own foundries and consuming works are absorbing a good proportion of the output, and much of the surplus iron available is being taken up by users in this district. Sales to other home areas, however, are on an improved scale, and more business with Scotland seems probable. As yet, transactions with firms on the Continent are not large, but inquiries from various quarters abroad inspire hope of early expansion of export trade. There is no immediate indication of output being increased by the re-lighting of more furnaces, however, although any greater expansion of demand necessarily would involve that course, stocks being nearly exhausted. No. 1 Cleveland pig iron is now 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; and No. 4 forge, 64s. 6d. per ton.

Hematite Pig Iron.

Supply of East Coast hematite is very ample, but the curtailment of output as the result of the blowing out of two furnaces at the Ayresome Ironworks, Middlesbrough, this week, and the prospect of some improvement in both home and continental demand, promise to enable producers to take a rather firmer stand. Quotations are substantially below cost of output, and it is difficult to discover indication of early and sufficient change to remedy the situation. At the same time values show some little upward tendency.—Mixed numbers are at 70s., and that price rules rates for parcels of iron made to analysis to suit customers.

Ironmaking Materials.

Transactions in foreign ore are few, but existing conditions and the future outlook enable sellers to take a firm stand, and they name 22s. as the c.i.f. price of best Rubio. The strike of ore miners in Sweden continues, and news to hand holds out little hope of an early termination of the dispute. The makers of blast-furnace coke in Durham are experiencing difficulty in upholding the unprofitable prices at which their output is selling. Ironmasters are not buying freely, and they report that they can readily satisfy their needs at 18s. per ton for good average qualities.

Manufactured Iron and Steel.

A moderate business is passing in manufactured iron, while semi-finished steel is selling much better now that prices of continental products are barely competitive in this country when cost of conveyance is added. Improvement in demand for certain descriptions of finished steel is noticeable, and business in shipbuilding material includes one or two export sales. Prices are unchanged.

The Coal Trade.

Very difficult conditions prevail in the Northern coal trade. To add to the troubles of the collieries, the output is going down, due to the discontent over the wages awards. The first pays after the reduction of the percentage addition to basis rates have been made, and this has not tended to improve matters. The miners are undoubtedly having a hard time, but the coal they produce has to be sold at a very low price for export, in order that this trade may not be altogether lost. Miners' wages abroad are lower, but they are seeking for something better The great demand for Polish coal has given them a measure of prosperity, which was not experienced previous to the development of Poland's export business. Northern colliery owners have no easy task in securing fresh trade, with steam prices at their present fixed level, and in face of Scottish and Polish competition. So far as one can gather, the majority of the collieries are determined to keep to current values, even if it means lost time at the pits for want of orders. It will probably mean a certain number of idle days, for there may not be sufficient trade to keep the collieries in regular work. If foreign consumers can buy more cheaply elsewhere, they will not come to Durham and Northumberland for their fuel. All the same, prices are even now at an unremunerative level, and the collieries were bound to make a stand sooner or later against continued lowering of values. The situation is full of perplexities so far as steam coals are concerned. Best Northumberland steams are quoted 13s. 6d., but there is little business passing. The prompt inquiry has fallen away, and for forward delivery consumers abroad are not prepared to pay current figures. Gas coals are perhaps just a shade better situated, as contractors are covering their immediate commitments. Sellers ask late prices, but there is no real strength in any section. Coking and bunker coals are dull, and the export position of coke is not improved by a decision of the Italian Government to place an import duty of 2s. 6d. per ton on coke. It constitutes one more trade barrier against English exports. Gas coke for this month's delivery is quoted more freely, but buyers are scarce, and press for concessions. First-hand quotations, however, hold steadily to 21s. to 21s. 6d. Patent oven cokes are abundant and easy in tone. Good qualities are quoted at 17s. to 17s. 3d., special makes, 23s. to 24s. ; and beehive, 24s. to 28s.

SCOTLAND.

(From our own Correspondent.)

Steel.

THE steel market as a whole remains decidedly dull. In some branches, however, a change is noticeable in the direction of firmer or advancing prices. Heavy steel prices are unchanged for home delivery, but export values may be altered. The scarcity of specifications for shipbuilding material is still pronounced, and demands from other quarters are not sufficient to maintain constant employment. Continental competition is not so keen, and home producers are more hopeful that the disparity in prices between home and continental materials will before long be sufficiently reduced to enable them to compete successfully in foreign markets. Already some materials are nearing the competitive level.

Steel Sheets.

The demand for the heavier gauges of black sheets is quiet, but the tone is somewhat firmer. Galvanised sheets recently touched £13 per ton for 24 gauge, but it is now said that it would take a very good offering to secure a quotation under £13 5s.

Bar Iron.

Specifications for bar iron are far from numerous, and outputs are well below normal. Re-rolled steel bars, sections and hoops are in moderate demand however. Re-rolled steel remains at the level of £7 15s. per ton home and £7 per ton export.

Pig Iron.

Owing to the strengthening of the ore market, pig iron quotations present a firmer appearance. Business, however, continues on very modest lines, the output of the small number of furnaces in blast being in no wise taxed.

Scrap.

Supplies of scrap are not too plentiful. Heavy steel is quoted in the region of 65s. and heavy basic 60s. for prompt delivery, and it is doubtful if forward transactions could be concluded at these prices.

Exports and Imports.

Imports at Glasgow last week included 6800 tons of iron ore, 1800 tons chrome ore, and 1500 tons of steel and iron products. Exports of iron and steel amounted to 4000 tons. Fair consignments of machinery, tubes and structural material were dispatched to foreign countries. Pig iron shipments amounted to 862 tons, of which all but 96 tons went to foreign destinations.

Coal.

The lack of export orders is still the predominant factor in the Scottish coal trade. Fresh shipping orders are very difficult to negotiate, and despite the efforts of collieries to prevent quotations falling below current levels, the tendency continues in a downward direction. With the exception of Lanarkshire splints, all descriptions of round coal are in need of business, while washed materials are similarly placed in all districts, and especially so in the Lothians and Fifeshire. Home demands also are disappointing. Aggregate shipments amounted to 203,868 tons against 219,693 tons in the preceding week and 233,052 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

ALTHOUGH new business continues to be slow, the fact remains that the conditions in the steam coal trade are a shade better. This applies more especially to the higher grades, but lower qualities remain short of orders. Evidence is forthcoming that slightly more activity prevails in the returns of shipments from this district for the week ended the 9th inst. The total was just over 450,000 tons, which compares with rather more than 419,000 tons for the previous week. Only on one occasion this year has the total of last week been exceeded, which shows that collieries must have been better engaged. It is interesting to note that while the returns were so satisfactory, the week ended up with the number of idle loading berths at forty-one, which points to the fact that some very good work must have been accomplished at the docks. While it is impossible to look very far ahead, there are indications that shipments will continue fairly good, as tonnage arrivals over last week-end were favourable. On Tuesday the position at the docks was that while there were twenty-one idle loading appliances there were fifteen steamers waiting to get into berths. Furthermore, chartering operations of late have been on a heavier scale. For the week ended the 9th inst. the total amount of tonnage reported as having been taken up was just over 350,000 tons, which compares with slightly less than 280,000 tons for the preceding week. On this showing there is therefore a fair amount of tonnage due to come along for loading in this district. New business of any material account has been limited. It is reported that the Bristol Electricity Works has contracted for 72,000 tons of Newport small coals for delivery over the next nine months, but in the case of the Portuguese State Railways, which recently asked for tenders for 100,000 tons of small coals for delivery during the next three months, it is understood that they have only purchased 30,000 tons.

Assistance for the Coal Industry.

A joint deputation of South Wales coalowners and miners' leaders waited upon the Government heads of departments last week in order to lay before them the serious conditions in the industry, but apparently the interview did not have very satisfactory results. The miners' representatives reported to a meeting of the Council of the South Wales Miners' Federation on Tuesday the reply which they received from the President of the Board of Trade. The President said that he could give no assurances in the matter of affording assistance to the industry, though he was prepared to lay the matter before the Prime Minister. The Council therefore decided to convene a further meeting of the joint deputation to consider the advisability either of making a further effort to place the position before the Prime Minister or of convening a meeting of the South Wales Parliamentary representatives so that the case might be presented through them.

Improved Docks Trade.

Returns issued by the Great Western Railway Company of traffic at the ports in this district under its control show an improvement for the four weeks ended February 19th as compared with the preceding four weeks. For the former period the total imports and exports came to 2,570,419 tons, which compares with 2,365,630 tons for the four weeks ended January 22nd. In the import section it is interesting to note that oil imports rose from 61,130 tons to 115,493 tons, while on the export side coal and coke exports were just over 100,000 tons better at the total of 1,888,207 tons. Taking the whole of the import and export trade from the beginning of this year to February 19th the aggregate is 4,573,964 tons, which, however, is not as good as the figure for the same period of last year, when the total amounted to 5,013,288 tons. It should be pointed out that in the returns of imports for the first eight weeks of 1927 there was included no less than 122,194 tons of coal which were brought to this district as the result of the national coal stoppage in this country in 1926. Still, even allowing for this, trade so far this year does not compare favourably with last year.

Tin-plate Trade.

There has been very little change in the conditions prevailing in the tin-plate trade in this district, though prices continue steady. An order for 60,000 boxes for the East was recently reported. The ballot is now proceeding of the higher paid men in the trade as to whether they will accept an offer from the employers of an *ex gratia* bonus of 2½ per cent. for six months, with the condition that no new claims of a general character are made during that period, or whether they will refuse it and consequently be in a position to submit fresh claims. It is expected that the result of the ballot will be made known on the 20th inst.

Current Business.

The inquiry on the coal market continues to be quiet, and yet at the same time the collieries are undoubtedly better stemmed. This is especially the case with those concerns producing the superior grades of coal. In a few instances they are in quite a good position, and for fresh supplies of best Admiralty large, salesmen are quoting 19s. 3d. and refusing to take less. Inferior descriptions of large are not so well placed for prompt orders, but the small coal market remains firm, and the better qualities are comparatively scarce, while sized coals are very steady. The demand for patent fuel is somewhat limited, while pitwood is easy.

CONTRACTS.

ROBERT STEPHENSON AND CO., Ltd., have received the following orders:—Crown Agents, Ceylon Railway, five 2–6–4 type bogie tank engines; Crown Agents, Nigerian Railway, six 4–8–0 type locomotive engines and tenders.

G. D. PETERS AND CO., Ltd., of Windsor Works, Slough, have secured an order for the supply of a further 154 sets of pneumatic door operating gear with electrical control equipment for the coaches now under construction for the Piccadilly-Brompton section of the London Electric Railway by the Union Construction Company, of Feltham. The value of this important order is upwards of £20,000.

LAUNCHES AND TRIAL TRIPS.

PUNTA BENITEZ, oil tanker; built by Harland and Wolff, Ltd., to the order of the Lago Shipping Company; dimensions, 315ft. by 58ft.; 2360 gross tonnage. Engines, twin-screw, triple-expansion, pressure 180 lb.; constructed by the builders; launch, February 21st.

SAUGOR, steamer; built by Harland and Wolff, Ltd., to the order of James Nourse, Ltd., of London; dimensions, 439ft. 6in. by 56ft. by 31ft. 4in.; 5800 gross tonnage. Engines, triple-expansion, 26in., 44in., and 74in. diameter by 51in. stroke, pressure 180 lb.; constructed by the builders; launch, February 21st.

PACIFIC PIONEER, twin-screw motor vessel; built by the Blythswood Shipbuilding Company, Ltd., to the order of the Gulf Line, Ltd.; dimensions, 450ft. by 60ft. by 42ft. Engines, twin sets of single-acting Diesel; constructed by John G. Kincaid and Co., Ltd.; trial trip, February 24th

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Following upon the decision not to proceed with the proposed summer meeting in Norway, the Council of the Institution of Electrical Engineers have received and accepted an invitation from the Committee of the Scottish Centre to hold the meeting in Scotland from June 26th to 29th, inclusive. Visitors will assemble in Glasgow on Monday, June 25th, the proceedings commencing the following morning. The programme will include one day each in Glasgow and Edinburgh and an excursion into the Western Highlands, including a visit to Lochaber. The meeting will break up at Oban on the morning of June 30th.

THE CHILIAN TORPEDO-BOAT DESTROYER ORELLA.—The second of the six torpedo-boat destroyers ordered by the Chilian Government was successfully launched at the Woolston Works of John I. Thornycroft and Co., Ltd., Southampton, on Thursday last, March 1st. The new vessel, which was named the Orella by Madame Costa Pellé, the wife of Captain Costa Pellé, Chief of the Chilian Naval Commission, has a length of 300ft. with a beam of 29ft. and a maximum draught of 12ft. 6in Her fully loaded displacement will be about 1430 tons and the contract speed is 35 knots. The boilers are of the Thornycroft water-tube type with the firm's oil fuel gear, and the propelling machinery comprises a twin-screw arrangement of compound turbines with geared turbines for cruising speeds. Three 4·7 quick-firing guns are to be fitted along with six 21in. torpedo tubes. The vessel will also have powerful anti-aircraft and anti-submarine armament.

ROAD TRANSPORT ILLUMINATION DEMONSTRATION.—In 1925 the Royal Automobile Club, which has for many years carried on most valuable work in the testing of anti-dazzle lamps and devices, held an interesting demonstration in Richmond Park of such "dazzle cures." It was clear at that demonstration that the progress made up to that time was disappointing, but a very useful purpose was served by showing that the time was not then ripe for legislation. Three years have now passed and the Club announces the holding of a similar demonstration, again in Richmond Park. The demonstration this time should be even more interesting, because, apart from the fact that another three years' development has taken place in anti-dazzle devices, the character of the demonstration is to be considerably extended. By widening the title to that of "Road Transport Illumination Demonstration" it will be possible to include the following:—Anti-dazzle headlamps and devices, swivelling headlamps; illuminated road signs, including warning signs and signposts; illuminated traffic signals, automatic and otherwise; side lamps of different powers; cycle rear reflectors; illumination of rear number plates; and road works danger lamps. The date fixed for the demonstration is Thursday, March 29th, 1928, at 8.30 p.m. As in 1925, the Ministry of Transport will be represented at the demonstration. The R.A.C. invites entries from any interested parties who may desire to demonstrate any particular device or system coming under any of the above-mentioned heads. The demonstration will be of a non-competitive character and no awards will be made. No entry fees will be charged. Application forms may be obtained from the Secretary, Technical Department, R.A.C., Pall Mall London, S.W. 1.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	19/- to 21/-
(1) Spanish	19/- to 21/-
(1) N. African	19/- to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d	Export. £ s. d.
(2) Scotland—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0	—
No. 3 Foundry	3 10 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 10 0	3 10 0
No. 1	3 10 6	3 10 6
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 3 6	—
(3) Northampton—		
Foundry No. 3	3 0 0 to 3 1 0	—
Forge	2 14 0	—
(3) Derbyshire—		
No. 3 Foundry	3 4 0 to 3 4 6	—
Forge	2 19 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0	—
No. 4 Forge	3 2 6	—
Basic	3 2 6	—
(4) N.W. Coast— N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 2 0 (a) / 4 5 0 (b) / 4 8 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	10 0 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 5 0 to 10 5 0	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0	—
Gas Tube Strip	11 10 0	—

STEEL. (d)

	(6) Home. £ s. d	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 12 6	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 5 0	13 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 2 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
Manchester—		
Bars (Round)	8 17 6	—
,, (Small Round)	7 12 6	—
Hoops (Baling)	10 5 0	10 0 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6	—
,, (Lancs. Boiler)	10 0 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 2 6 to 7 12 6	—
Intermediate Basic	7 0 0	—
Soft Basic	6 5 0	—
Hoops	9 10 0 to 10 10 0	—
Soft Wire Rods	7 10 0	—
Midlands—		
Small Rolled Bars	7 7 6 to 8 0 0	—
Billets and Sheet Bars	5 15 0 to 6 0 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 7 6 to 13 10 0	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	17/9 to 18/3
Block Tin (cash)	224 10 0
,, (three months)	226 15 0
Copper (cash)	61 3 9
,, (three months)	61 2 6
Spanish Lead (cash)	19 16 3
,, (three months)	20 6 3
Spelter (cash)	25 2 6
,, (three months)	25 0 0
Manchester—	
Copper, Best Selected Ingots	66 0 0
,, Electrolytic	67 0 0
,, Strong Sheets	92 0 0
,, Tubes (Basis Price), lb.	0 1 1
Brass Tubes (Basis Price), lb.	0 1 0
,, Condenser, lb.	0 1 2
Lead, English	21 7 6
,, Foreign	20 5 0
Spelter	25 7 6
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/7½ per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 15 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 7 6	7/-
,, ,, 8 p.c. to 10 p.c. ,,	£22 5 0	6/-
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£35 0 0	12/-
,, ,, ,, 1 p.c. carbon	£40 10 0	15/-
,, ,, ,, 0·70 p.c. carbon	£50 0 0	17/-
,, ,, ,, carbon free	1/2 per lb.	
Metallic Chromium	2/11 per lb.	
Ferro Manganese (per ton)	£13 10 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 17 6 scale 5/- per unit	
,, ,, 75 p.c.	£20 10 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	4/11 per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£172	
Ferro-Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	14/6
,, ,, Splint	16/9 to 17/3
,, ,, Trebles	13/6
,, ,, Doubles	12/6
,, ,, Singles	11/-
Ayrshire—	
(f.o.b. Ports)—Steam	13/-
,, ,, Jewel	15/6
,, ,, Trebles	13/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	10/6 to 12/-
Screened Navigation	18/-
Trebles	12/- to 12/3
Doubles	12/-
Singles	11/-
Lothians—	
(f.o.b. Leith)—Best Steam	12/3
Secondary Steam	12/-
Trebles	12/3
Doubles	11/6 to 11/9
Singles	11/3

ENGLAND.

(8) N.W. Coast—	
Steams	24/- to 25/-
Household	37/6 to 50/-
Coke	22/6 to 23/6
Northumberland—	
Best Steams	13/6
Second Steams	11/9 to 12/-
Steam Smalls	10/-
Unscreened	11/9 to 12/-
Household	21/- to 27/-
Durham—	
Best Gas	15/3
Second	13/3 to 13/9
Household	21/- to 27/-
Foundry Coke	18/6 to 19/-
Sheffield— Inland.	
Best Hand-picked Branch	27/6 to 29/6 —
Derbyshire Best Bright House	20/6 to 21/6 —
Best House Coal	19/- to 20/6 —
Screened House Coal	16/- to 17/6 —
,, ,, Nuts	15/- to 16/- —
Yorkshire Hards	14/6 to 15/6 —
Derbyshire Hards	14/- to 15/6 —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/- to 7/- —
Smalls	3/- to 4/6 —
Blast-furnace Coke (Inland)	13/- at ovens —
Furnace and Foundry Coke (Export), f.o.b.	17/- to 18/-

(9) SOUTH WALES.

Cardiff— Steam Coals :	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/6 to 19/-
Best Dry Large	18/- to 18/6
Ordinary Dry Large	17/6 to 18/-
Best Black Vein Large	17/- to 17/3
Western Valley Large	16/6 to 16/9
Best Eastern Valley Large	16/6 to 16/9
Ordinary Eastern Valley Large	16/- to 16/3
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	11/- to 12/6
Washed Nuts	18/- to 23/-
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	14/9 to 15/3
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	12/6 to 13/6
Foundry Coke (export)	30/- to 37/6
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	21/6 to 23/-
Pitwood (ex ship)	26/3 to 26/9
Swansea— Anthracite Coals :	
Best Big Vein Large	30/- to 32/6
Seconds	24/6 to 27/6
Red Vein	20/6 to 25/-
Machine-made Cobbles	38/- to 41/-
Nuts	37/6 to 42/6
Beans	23/- to 27/-
Peas	17/- to 18/-
Breaker Duff	8/- to 8/6
Rubbly Culm	9/6 to 10/-
Steam Coals :	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	9/9 to 11/-
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

A Coal Cartel.

THE French coal output during January underwent a still further increase, as compared with the previous month, and coalowners are again appealing to the Government to provide the means of disposing of their production, either by imposing higher import duties on coal or by a reduction of the railway rates on the carriage of fuel. Consumers affirm that the situation is far more satisfactory than is represented, and that there is no reason for adopting measures which may tend to increase the price of coal. In the Saar the State Administration working the collieries has had to discharge 6000 men. It is believed that the situation of French coalowners will, if anything, be improved if there should be grounds for the rumour that preliminary negotiations are on the point of being entered into between British and German colliery proprietors for the control of foreign markets. The object is to create a species of cartel for the coal trade, similar to what has been done in the case of steel. The production would be limited to the consumption and prices would be regulated for the export markets. The Polish coalowners are alarmed at the prospect of a cartel being formed from which they would be excluded, as they believe that a British-German combination would shut them out of the foreign markets altogether.

Naval Manœuvres.

The policy of the Minister of Marine, Monsieur Leygues, is not only to create a new navy adapted to modern needs, but also to keep it in a state of efficiency, which is also something new, for under the old system it was always complained that for the sake of economy the ships spent too much of their time in ports and the officers and men did not have sufficient opportunities for training. Now all the ships are in active service, and some are sent occasionally on long cruises, especially to the colonies, where it is sought to revive confidence in the country's naval power. Monsieur Leygues considers that the reconstitution of the navy is sufficiently advanced to justify the carrying out of important manœuvres in the coming summer, and they will begin with a big demonstration at Cherbourg and Havre towards the end of June. At Cherbourg there will be a grouping of seaplanes, including forty-two huge "Goliaths," and the aircraft demonstration will probably be the largest yet undertaken. The ships will concentrate at Havre for a review preparatory to the manœuvres.

Loire Navigation.

The Loire is a shallow river with changing channels, which would render inestimable service if it could be made navigable between the industrial regions of the centre and the Atlantic. In carrying out the scheme for diverting international traffic through France, either the Loire must be canalised or a lateral canal must be constructed, and as either undertaking would be costly, an attempt was made about twenty years ago to deepen the bed of the river by an automatic scouring of the sandy bottom. Between Angers and Nantes stakes were driven into the bed to hold masses of reeds and brushwood which were expected to produce a current in the middle of the river and thereby deepen the channel sufficiently for navigation. After all these years it is found that the results are disappointing, and that, moreover, the artificial reedy banks constitute an obstacle to the flow of the river in times of flood. It has therefore been decided to abandon the experiment. Other works are to be carried out in order to facilitate the flow of the river and lessen the risks of flooding, which are at present very serious, but the idea of rendering the Loire navigable, except on certain limited sections, has been definitely abandoned.

Hydro-electric Installations.

The granting of a concession for the construction of four power stations on that portion of the Dordogne lying between the first section exploited by the Paris-Orleans Railway Company and the town of Argentat marks a further stage in the complete utilisation of the hydraulic resources of that river, which, according to the Ministry of Public Works, is capable of producing 2000 million kilowatt-hours a year. On the first section the Coindre and Roche-le-Peyroux stations have been completed, and two other installations at Chavanon and Morèges are to be put in hand. The original concession provided for three barrages of 109 m., 46 m., and 9 m., but it has been found more economical to replace the biggest barrage by two dams, one of 87 m. and another of 40 m., and work will be started upon the 87 m. barrage at Aigle. It is estimated that the cost of the current produced will be a little less than 6 centimes per kilowatt-hour. The concession has been accorded to the XVII. Groupement Régional des Chambres de Commerce, which undertakes to form a company to carry out the work with the aid principally of manufacturers and other users. The State will give assistance by supplying material obtained from Germany on account of reparations, and will receive shares in proportion to the material thus furnished.

A Desert Bridge.

The construction of a macadam road in the place of the track which formerly extended from Algiers to the town of Laghouat in the oasis of that name, has provided ample facilities for transport between the north and south of the Department, but Laghouat is separated from the route by the Mzioued, which in the rainy season is often impassable. In constructing a bridge across the river difficulties were encountered, not only on account of the sandy nature of the ground, but also of the heavy pressures of water during floods. The work was undertaken by the Société des Ponts et Travaux en Fer, which began the construction in March, 1926, and completed it in less than two years. Foundations had to be sunk through the sand to rocks at a depth of 15·18 m. There are seven spans on concrete piles. The length of the bridge, exclusive of the approaches, is 224 m., and the width is 8 m.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

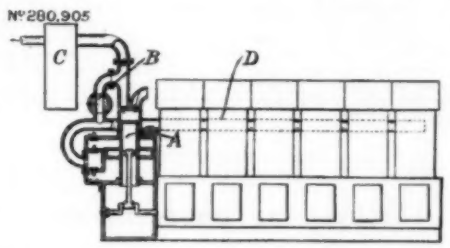
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

280,905. November 10th, 1927.—IMPROVEMENTS IN AIR PUMPS FOR USE WITH DIESEL ENGINES, Fried. Krupp Germaniawerft Aktiengesellschaft, of Kiel-Gaarden, Germany.

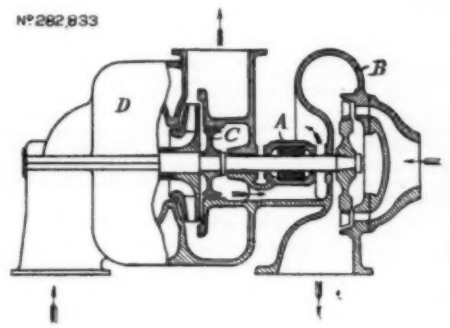
This invention relates to air pumps for use with Diesel engines intended for vehicles, and comprises a charging pump to supply supplemental charging air in order to increase the output of the engine and also an air pump that delivers the starting and braking air. The pump intended for the production of starting



and braking air is combined with the supplemental charging air pump in such a manner that its piston forms a common differential piston A with the piston of the supplemental charging air pump. A throw-over valve B is provided, by means of which the braking air pump may be connected to the compressed air receiver C for starting or braking air or to the supplemental charging air pipe D.—*February 2nd*, 1928.

282,833. December 30th, 1927.—A METHOD OF COOLING EXHAUST TURBO BLOWERS FOR DIESEL ENGINES, Brown, Boveri et Cie., of Baden, Switzerland.

For driving, supercharging and scavenging air blowers for internal combustion engines gas turbines are frequently employed, which are driven by means of the exhaust gases of the Diesel engine. These exhaust gases have temperatures which may exceed 500 deg. Hence it is in many cases necessary to

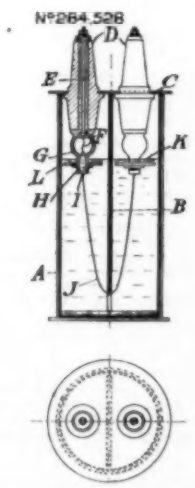


cool the bearings, glands, shafts and even the bearing pedestals of these turbines, more particularly when the gas turbine is flanged to the casing of the blower without other support, and has a common bearing with the casing. Water has been used for cooling, but in many cases the provision of this water has caused difficulty, and in accordance with the invention it is proposed to use air. In the accompanying drawing the bearing A of the gas turbine B is cooled by air which flows from the balance piston C of the blower D.—*February 2nd*, 1928.

SWITCHGEAR.

284,528. June 10th, 1927.—AN IMPROVED AUTOMATIC ELECTRIC CIRCUIT BREAKER, Henri Pecheur, of 58, Boulevard Victor Hugo, Saint-Ouen (Seine), France.

A circuit breaker made according to this invention is shown

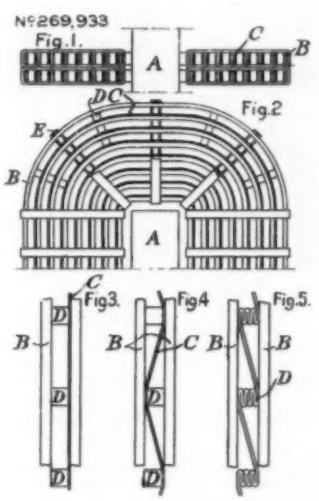


in the drawings. The cylindrical steel tank A is lined inside with an insulating facing. A partition B fixed to the lid C divides the tank diametrically into two compartments communicating at the lower end. On the lid there are two insulators D with rods E connecting the terminals with the fuses F. The fuse is situated in a chamber G in which the explosion or high pressure of the gases is produced and the chamber is prolonged by a tube or passage H in which a plug I of insulating material and preferably of light weight is fitted by friction. A conductor rod runs through the axis of this plug. The fuses F and the flexible conductor J are fixed to the ends of the rods. The tank is filled with oil to the level K. Deflectors L are provided to limit the splashing of oil against the lid C. The circuit is closed through the flexible conductor J and the two fuses in series. In the event of a short circuit blowing the fuse F an explosion or high pressure of the gases is set up in the chamber G and consequently a rapid ejection of the plug I occurs. An arc is struck between the side of the explosion chamber and the conductor passing through the plug, but at the instant when the plug is blown out the arc is broken. The break is made in the liquid very rapidly, the time varying in inverse proportion to the speed of the projected plug, and consequently the violence of the short circuit. The apparatus is suitable for breaking circuits working at a pressure of 15,000 volts.—*February 2nd*, 1928.

TRANSFORMERS AND CONVERTERS.

269,933. April 23rd, 1927.—IMPROVEMENTS IN OR RELATING TO DISC COILS FOR TRANSFORMERS, Siemens-Schuckertwerke Gesellschaft mit beschrankter Haftung, of Berlin-Siemensstadt, Germany.

The iron core A in Figs. 1 and 2 is surrounded by the coil B of copper bar. Between adjoining layers there is a fibrous material band C on which small wood blocks D—Fig. 3—are glued. During the manufacture of the coil on the former or template the band C is placed on the copper bar conductor B and is coiled or wound with it. The blocks D are preferably so arranged on the band C that after the winding of the coil they form radial rows. In

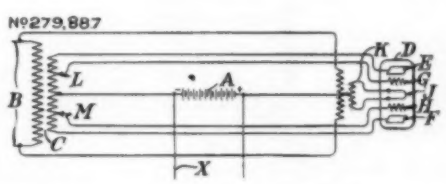


each row the coil is surrounded with a binding E which can be produced by winding a strip of fibrous material provided with glue in several layers round the coil. In Fig. 3 the band C is arranged on the conductor. The cooling medium, for instance, oil, cannot therefore play on the conductor at this side, but this drawback is avoided by arranging the blocks as shown in Fig. 4, alternately at different sides of the band. The band then passes in a zigzag manner between adjoining conductors. Another construction of the band is shown in Fig. 5, where the distance pieces D are made by folding the band several times, and the folds are glued together.—*February 2nd*, 1928.

ELECTRICAL APPLIANCES.

279,887. October 28th, 1927.—IMPROVEMENTS IN ELECTRIC BATTERY CHARGING SYSTEMS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.* 2.

This invention relates to an electric storage battery charging system, including a source of alternating current and a thermionic rectifier which is provided with a grid adapted to control the starting of the flow of current between the cathode and anode, the voltage of the grid being influenced by the voltage of the battery that is being charged so as to change the current supplied to the battery through the rectifier as the voltage of the battery changes. The storage battery A is connected to the alternating-current supply lines B through a transformer C and a space discharge device D. This device contains a gas, such as mercury vapour, and is provided with anodes E and F, grids G and H, and a cathode J. Heating current is supplied to the cathode from the alternating-current circuit B through a transformer K. It will be observed that points on the secondary windings of the



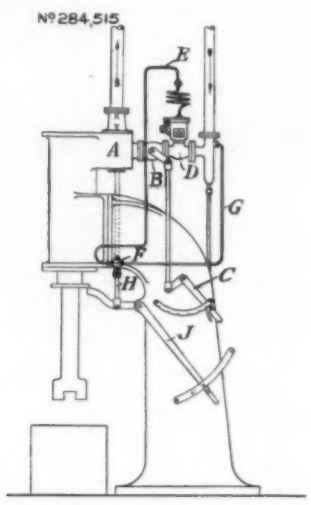
transformers C and K are interconnected through the battery A and that the grids G and H are connected to the cathode J through the battery A and secondary terminals L and M of the transformer C. With these connections three component voltages are applied between the most negative part of the cathode J and the grid which is positively charged at any given instant. Thus when the upper secondary end terminal of the transformer C has a positive polarity, the anode E and grid G are positively charged, the lower terminal of the cathode J is most negative, and the potential between this terminal and the grid G is the resultant sum of one-half the secondary voltage of the transformer K, the whole of the voltage of the battery, and the voltage of the secondary turns included between the negative terminal of the battery and the secondary terminal L. The battery may be permanently connected to a "translating" device through leads X. Assuming the various connections to be as illustrated and the alternating supply circuit B to be energised, the grid potentials of the device D are equal to resultant voltages which are the difference between the

voltage of the battery and the sum of the alternating voltages applied to the grid circuits through the transformers C and K. When the maximum sum of these alternating voltages is substantially equal to the battery voltage, no charging current is supplied to the battery for the reason that the potentials of the grids never become positive with respect to the most negative part of the cathode. As the voltage of the battery decreases, however, the resultant difference between the battery voltage and the sum of the alternating voltages increases and eventually becomes large enough to start the charging current through the rectifier.—*February 2nd*, 1928.

MACHINE TOOLS AND SHOP APPLIANCES.

284,515. May 21st, 1927.—IMPROVEMENTS IN AND RELATING TO STEAM HAMMERS AND LIKE MACHINES, The Midland Railway Carriage and Wagon Company, Ltd., of Midland Works, Birmingham; and Albert Victor Bayliss, of the same address.

The usual hand lever mechanism for operating the piston or other valve of a steam hammer is adapted so that when it is brought to the standing or rest position it opens a pilot valve which admits steam to an auxiliary cylinder which closes a stop valve in the supply main to the working cylinder. The object of the invention is to avoid waste, the steam being automatically cut off when the machine is idle, independently of the workman. In the drawing the main piston valve is shown at A. Between the main steam pipe and the piston valve there is a stop valve B operated from a handle C and an auxiliary steam-operated stop valve D. The valve D is connected by a pipe E to a pilot valve F which is connected by a pipe G to the main steam pipe. The

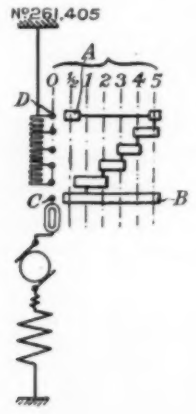


pilot valve is adapted to be opened by an arm on the rod H of the piston valve when the hand lever J is brought to the normal rest or standing position as shown. Steam can then pass from the main steam pipe through the pipe G pilot valve F and pipe E, to the stop valve D, which cuts off the supply of steam. Immediately the hand lever J is moved to re-commence working, the pilot valve F is closed and the stop valve D is then opened by the pressure of steam from the main with the assistance of a spring. The inventors point out that by means of the piston valve steam can be cut off from the cylinder so that the piston is brought to rest, but with the piston valve in this position steam can still pass from the inlet to the exhaust, and therefore when the machine is not in operation steam should be shut off by means of the stop valve. In practice it is extremely difficult to get workmen to attend to this point, with the result that with the ordinary arrangements the loss of efficiency is considerable.—*February 2nd*, 1928.

TRAMWAYS AND RAILWAYS.

261,405. November 13th, 1926.—IMPROVEMENTS IN OR RELATING TO SYSTEMS OF ELECTRIC BRAKING, International General Electric Company, Incorporated, of 120, Broadway, New York.

The electric braking system described in this specification is characterised by the fact that a special segment A is provided on the braking part of the controller by means of which a resistance in the braking circuit is wholly or partly temporarily short-circuited once or several times during the braking operation. The object of the invention is to avoid delay in the braking

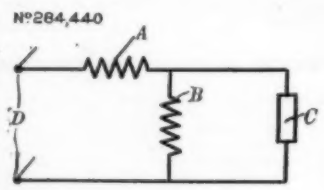


effect. The illustration shows the part of the controller used for braking. The position O is the switching-off position; in the other positions the braking resistance is short-circuited in steps in the well-known manner. The additional segment A comes into contact with the finger B between the positions 0 and 1. This intermediate position, indicated by ½, is not arranged on the star wheel as a rest position, but is switched over quickly. The contacts B and C come into contact simultaneously with the contacts A and D, and it will therefore be seen that the entire resistance is short-circuited at the position marked ½.—*February 2nd*, 1928.

MISCELLANEOUS.

284,440. December 17th, 1926.—IMPROVEMENTS IN OR RELATING TO ELECTRICAL IMPEDANCE NETWORKS, The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C. 2; and Albert Charles Bartlett, of Research Laboratories, of the General Electric Company, Ltd., Wembley, Middlesex.

This specification describes an electrical circuit for use with an electrical network containing inductance and capacity. The circuit comprises a positive resistance A in series with the net-



work and a negative resistance B in parallel with it, the values of these resistances being such that when a variable voltage is applied to the terminals D of the combined network and circuit the variable current through the network has the same wave form as the variable voltage. C is the impedance through which the current is required to flow. The negative resistance may be provided by means of a thermionic valve known as a dynatron. A modification of the scheme illustrated is described.—*February 2nd*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Paper, "The Reorganisation of Crewe Locomotive Works," by Captain H. P. M. Beames. 6 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—92, Victoria-street, London, S.W. 1. Metropolitan District meeting. 6 p.m.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS.—Lecture Theatre of the Royal United Service Institution, Whitehall, London, S.W. 1. Lecture, "The Development of High-speed Aircraft," by Major J. S. Buchanan. 5.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Chairman's address, "An Outline of Petroleum Distribution," by Mr. W. M. Hurrell. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "The Quantum and Relativity Theories of Light," by Professor E. T. Whittaker. 9 p.m.

WEST BROMWICH ENGINEERING SOCIETY.—Technical College, West Bromwich. "Metallurgical Defects and Failures in Engineering," by Professor D. Hanson. 7.30 p.m.

SATURDAY, MARCH 17TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, JUNIOR SECTION.—The College of Technology, Sackville-street, Manchester. "Mass Production in the Foundry," by Mr. J. Yates. 7 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Eastern District meeting at Ipswich. 2 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South-Western District meeting at Exmouth.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "The Transformation of Matter," by Sir Ernest Rutherford. 3 p.m.

MONDAY, MARCH 19TH.

BRADFORD ENGINEERING SOCIETY.—Bradford Technical College, Bradford. "Steam Meters," by Mr. J. L. Hodgson. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Informal meeting. Discussion on "The Registration of Engineers," opened by Mr. W. A. Erlebach. 7 p.m.

RAILWAY CLUB.—25, Tothill-street, London, S.W. 1. Paper "A Railway Journey in Spain," by Mr. W. A. Willox. 7.30 p.m.

TUESDAY, MARCH 20TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—The Engineers' Club, Waterloo-street, Birmingham. "Non-Ferrous Tubes," by Mr. W. E. Ballard. 7 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow. Paper, "The Development of the Fiat Marine Oil Engine," by Ing. Giovanni Chiesa and Mr. D. M. Shannon. 7.30 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "The Chemical Engineer and the Steel Maker," by Dr. J. L. Pearson. 7.30 p.m.

THE INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Ordinary meeting. Paper to be submitted for discussion, "Mining Methods, Past and Present, in the Morro Velho Mine of the St. John Del Rey Mining Company, Ltd., and Lode Changes which have Necessitated an Alteration of System," by Mr. Alexander George North Chalmers. 6 p.m.

WEDNESDAY, MARCH 21ST.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington. The G. J. Symons Memorial Lecture on The Sun's Cycle of Activity," by Mr. H. W. Newton. 7.30 p.m.

ROYAL MICROSCOPICAL SOCIETY.—20, Hanover-square, London, W. 1. The following papers will be read and discussed: "A Nerve Mechanism in the Capillaries of Muscle," by Professor D. C. Blair, M.B., Ch.B.; "Contribution to the Study of Diatom Markings," by Dr. J. A. Murray, F.R.S., F.R.M.S.; "A Portable Microscope Table," by Dr. G. S. Sansom, D.Sc., F.R.M.S. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Modern Typewriter and its Probable Future Development," by Lieut.-Commander R. T. Gould. 8 p.m.

SOCIETY OF GLASS TECHNOLOGY.—The University, Leeds. Meeting of Refractories Committee, in the Board Room of the University, 10 a.m. Council meeting, in the Board Room of the University, 11.30 a.m. Luncheon, Hotel Metropole, 1 p.m. Ordinary general meeting, in Lecture Room of the Coal, Gas and Fuel Industries Department, the University. Papers: "The Study of a Fundamental Reaction in Glass Making," by J. T. Howarth, M.Sc., and Professor W. E. S. Turner; "A Method of Testing the Probable Durability of Tank Blocks," by Mr. E. J. C. Bowmaker, B.Sc. 2.30 p.m.

SOCIETY OF TECHNICAL ENGINEERS: LONDON BRANCH.—At the Engineers' Club, Coventry-street, London, W. 1. "Current Office Organisation," by Mr. N. Gerard Smith. 8 p.m.

THE INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Grand Hotel, Sheffield. A discussion on "Organisation as Applied to Engineering" will be opened by Mr. R. A. Thwaites, B.Sc., Assoc. M. Inst. C.E., and Mr. O. F. C. Bender, B.Sc., Assoc. M. Inst. C.E. 7.30 p.m. An informal dinner will be served in the hotel at 6.30 p.m.

THE NEWCOMEN SOCIETY.—In Prince Henry's Room, 17, Fleet-street, E.C. 1. Paper, "James Sadler: Aeronaut, Engineer, Chemist and Inventor," by Mr. J. E. Hodgson. 5.30 p.m.

THURSDAY, MARCH 22ND.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Electrical Research Association Report on "A Critical Study of the Continuous Rating of Low-pressure Ordinary Duty Fusible Cut-outs," by Mr. P. D. Morgan, B.Sc. (Eng.). 6 p.m.

THE INSTITUTION OF MECHANICAL ENGINEERS: YORKSHIRE BRANCH.—Hotel Metropole, Leeds. Discussion, "Payment by Results." 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "The Physiological Aspects of Flying," by Captain Martin Flack. 5.15 p.m.

FRIDAY, MARCH 23RD.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Mechanical Handling of Goods," introduced by Mr. J. H. Walker. 7 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Council House, Birmingham. West Midland District meeting. Lecture, "Birmingham's Elan Water Supply," with lantern slides, by Mr. F. W. Macaulay, M. Inst. C.E. 5.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria street, S.W. 1. Informal meeting. "High-tension and Low-tension Supply for Wireless Receivers from Electric Mains," by Mr. B. J. Axton. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Informal meeting in the Institution Library. Subject for discussion, "The Steering of Ships," to be introduced by Mr. H. G. Williams, O.B.E., Vice-President. 7.15 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "A Physical Chemist in Search of Purity in an Impure World," by Dr. Ernst Cohen. 9 p.m.

SOCIETY OF CHEMICAL INDUSTRY: CHEMICAL ENGINEERING GROUP.—Chemical Society, Burlington House, London, W. 1. "Ultra-violet Radiation in Industry," by Mr. Alfred A. King. 8 p.m.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—A meeting of the Institution will be held in the South Midland District at Luton, at eleven o'clock. Inspection of municipal works.

SATURDAY, MARCH 24TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "The Transformation of Matter," by Sir Ernest Rutherford. 3 p.m.

MONDAY, MARCH 26TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Graduates' Section meeting. Annual lecture, "The Trend of Modern Steam Locomotive Design," by Mr. R. E. L. Maunsell. 6.30 p.m.

WEDNESDAY, MARCH 28TH, TO FRIDAY, MARCH 30TH.

INSTITUTION OF NAVAL ARCHITECTS.—Spring Meetings. Royal Society of Arts, John-street, Adelphi, W.C. 2. For programme see page 302. Annual Dinner, Wednesday, March 28th, Connaught Rooms, Great Queen-street, London. 7.30 p.m.

WEDNESDAY, MARCH 28TH.

THE INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Students' informal meeting. Subject for discussion, "The Limitation of Concrete as a Material in Construction," by Mr. R. F. Legget. 6.30 p.m.

THURSDAY, MARCH 29TH.

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON).—Denison House, 296, Vauxhall Bridge-road, London, S.W. 1. "Engine Failures," by Mr. J. Clayton, M.B.E. 6 p.m.

FRIDAY, MARCH 30TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. "Locomotive Maintenance," by Mr. C. F. Adams. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Radio-active Atoms and their Structure," by Sir Ernest Rutherford. 9 p.m.

THE INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square. "Non-ferrous Metals in Relation to Ferrous Metallurgy," by Dr. W. H. Hatfield, D.Met. 7.30 p.m.

THE INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON): MANCHESTER CENTRE.—In the College of Technology, Sackville-street, Manchester. "Some Features of the Mechanical and Electrical Equipment of the Port of Manchester," illustrated by lantern slides, by Mr. W. G. Smith. 7 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WILLIAM BEARDMORE AND CO., Ltd., announce that Mr. John Black has been appointed chief naval architect and shipyard manager at their Naval Construction Works, Dalmuir. Mr. Black took up his new duties at the Dalmuir works on March 1st.

HUGH CAMPBELL, M.I. Mech. E., of Newstead, Halifax, founder of and for thirty-seven years managing director of the Campbell Gas Engine Company, Ltd., Halifax, desires us to announce that he has commenced the manufacture of vertical and horizontal oil engines of the high-compression cold starting airless-injection type.

TURTON BROTHERS AND MATTHEWS, Ltd., Sheffield, propose to transfer their London office as from the 17th instant from 77, Cannon-street, E.C. 4, to 23, College-hill, Cannon-street, E.C. 4, which is the London office of their subsidiary firm, J. P. Skinner and Co., Ltd., and the London business of the two firms will therefore be transacted at the latter address after the above-mentioned date.